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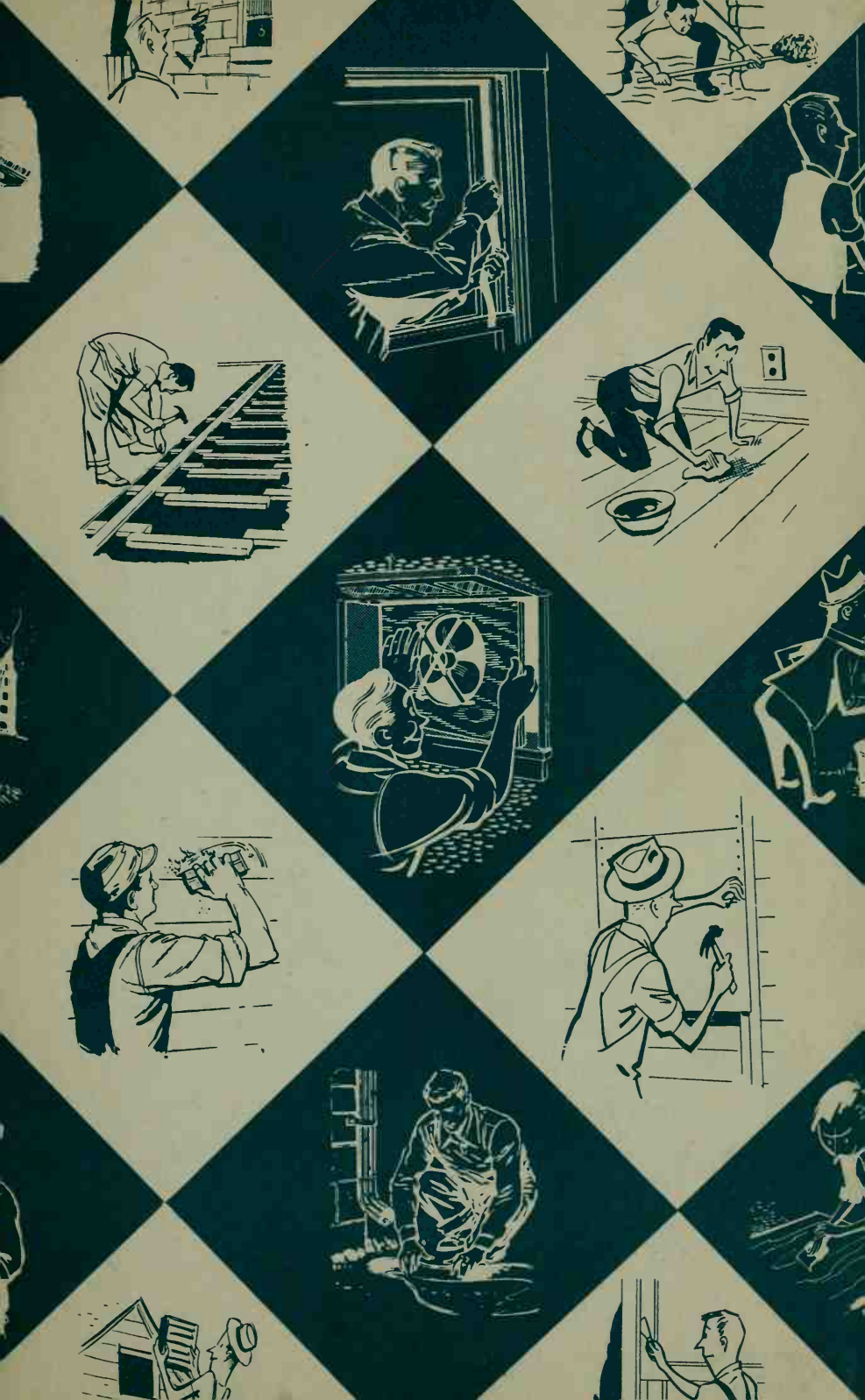

POPULAR MECHANICS DO-IT-YOURSELF ENCYCLOPEDIA

POPULAR MECHANICS DO-IT-YOURSELF ENCYCLOPEDIA

FOR

HOME OWNER, CRAFTSMAN

AND HOBBYIST

IN TWELVE VOLUMES

Volume X

Complete Index in Volume XII

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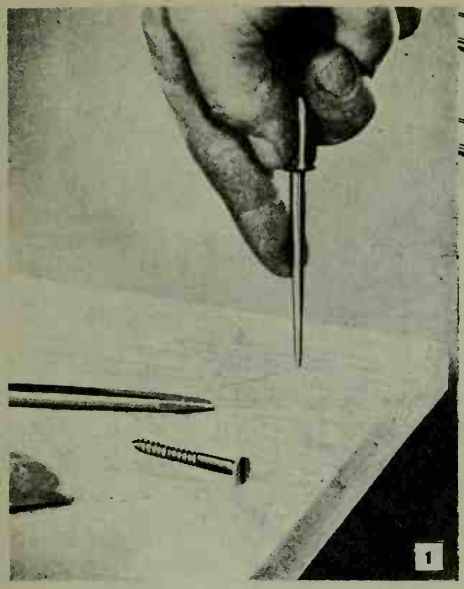
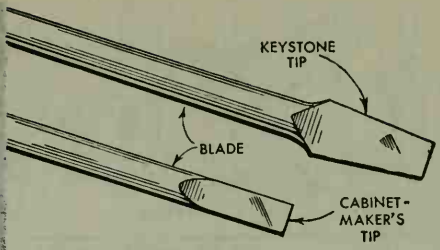
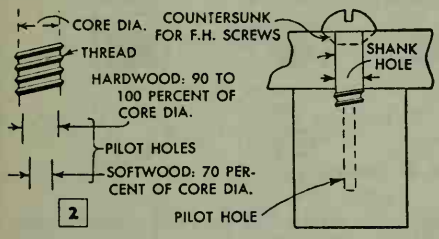
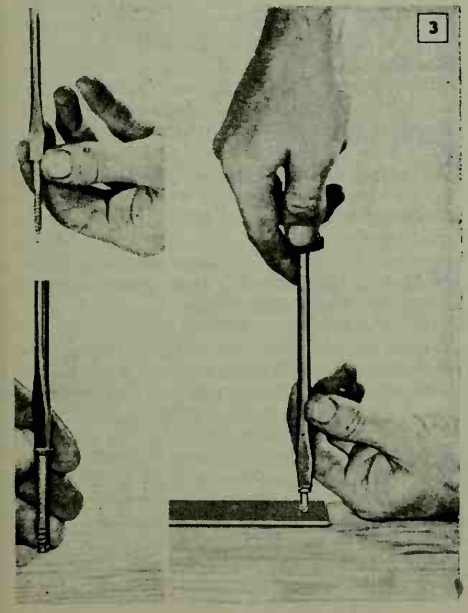




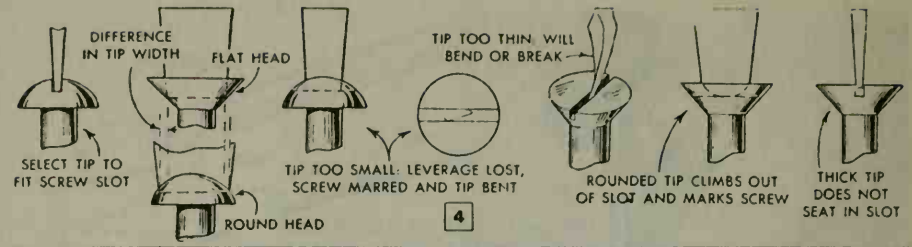
SCREW-DRIVER TECHNIQUES





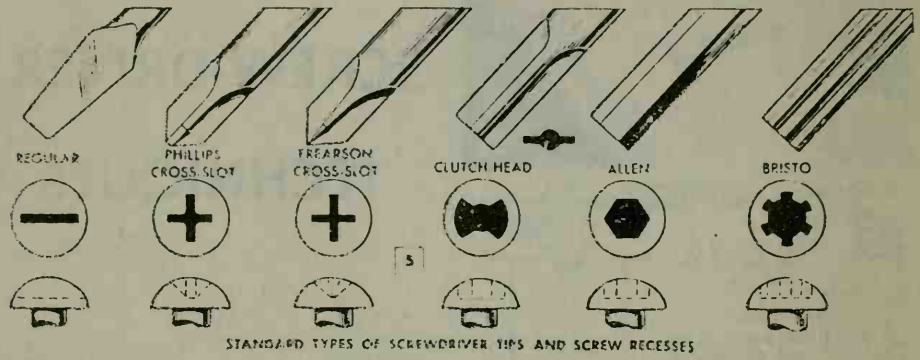
THE SIMPLE JOB of driving a screw into wood can result in a rather discouraging effort, or it can be made an easy operation if you utilize the tricks of the experienced workman. By following approved procedures you'll avoid injured fingers, marred work and damaged or broken screws.

Select correct screwdriver: Select a driver that fits the slot in the screwhead, both in width and length. It's important to remember that flat-headed screw slots are narrower at the bottom than at the top. If the screwhead is countersunk, the corners of a screwdriver blade that fits the full width of the slot will project and tear the wood as the screw is driven down flush. The correct width of blade to use is shown in Fig. 4. If the tip is too narrow, there will be considerable loss of leverage and more turning force or torque will be required to drive the screw. High-quality drivers are designed so that their tip widths and thicknesses are slightly less than the lengths and widths of standard screw slots, as shown in the table in Fig. 4. The blades and handles are proportioned in size to withstand any torque to which they are subjected in normal use. Square shanks can withstand



SIZE OF DRIVERS TO USE FOR DIFFERENT SIZE SCREWS

SCREW NUMBER	0	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	24	3/16"	1/2"	9/16"
REGULAR BLADE	3/32"			1/8"		1/8"-5/32"	3/32"-3/16"		3/16"		1/4"	1/4"-5/16"	5/16"	5/16"-3/8"	3/8"	3/8"-7/16"	7/16"	1/2"	1/2"-9/16"	9/16"
CROSS-SLOT BLADE	NO. 1					NO. 2					NO. 3			NO. 4						



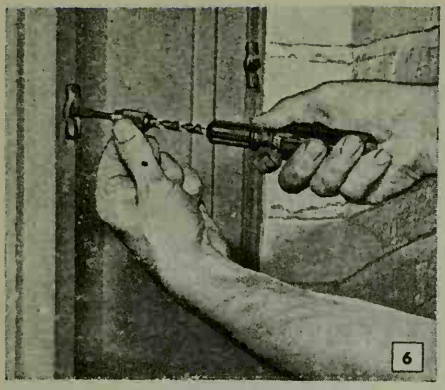
STANDARD TYPES OF SCREWDRIVER TIPS AND SCREW RECESSES

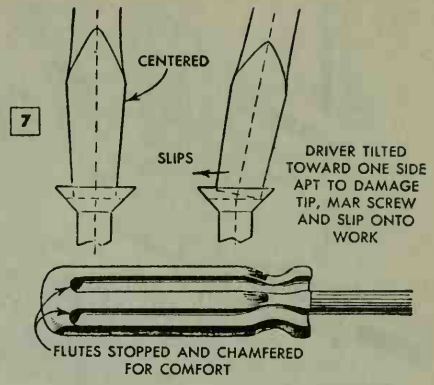
greater turning torque than round ones.

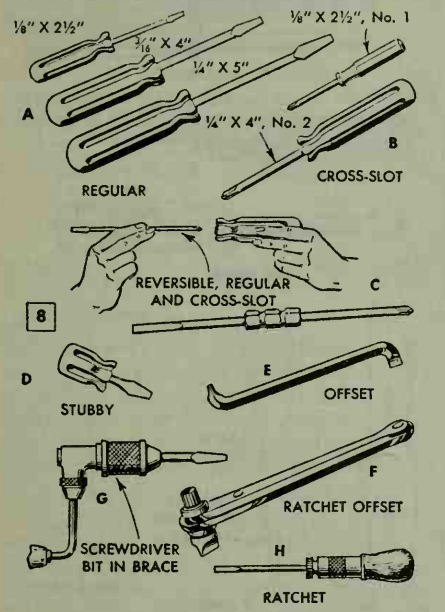
Types of driver tips: Fig. 5 shows various types of driver tips, or bits, and also the screwheads they fit. Ordinary slotted screws are the most common, but cross-slotted screws also are used extensively. The cross-slotted Phillips screwhead has modified U-shaped slots of uniform width and the Frearson screw has V-shaped slots with tapered sides. While a cross-slotted driver will fit into many sizes of the type of screw for which it is intended, it is best to use drivers of the proper sizes, as indicated in the table in Fig. 4. Drivers having clutch-head tips lock tightly in the screwheads when turned clockwise. The driver is unlocked simply by turning it in the opposite direction.

Driving a screw: The most common error in driving a wood screw is applying too much pressure on the driver when starting the screw. When starting small screws in softwood, punch a hole with an awl, Fig. 1, or other pointed tool. For large-size screws in softwood, and for all screws in hardwood, drill both a shank hole and a pilot hole, Fig. 2. Without a starting hole, ordinary screws tend to follow the grain of the wood and are difficult to drive straight. Providing a pilot hole eliminates the hard work of driving the screw and also prevents splitting the wood, especially near the edges and ends of the stock. For flat-headed screws, the shank hole should be countersunk so that the screwhead will seat flush with the surface. When a screw is used to attach metal to wood, Fig. 3, the upper part of the pilot hole is often enlarged to accommodate the screw shank, especially when driving screws into hardwood or when using large screws. Further ease of driving results from coating the threads with soft soap before starting. By following these simple precautions to minimize friction, screws won't break from driving strain.

When starting a screw, place it on the driver tip and hold both screw and tip together with the fingers of one hand, Fig. 3, while grasping the handle with the other hand so it rests comfortably in the palm. Then put the screw point in the starting hole, retaining the same grip but permitting the hand holding the screw to rest on the work. The screw should be at right angles to the surface unless the work requires that it be driven at an angle. Apply very little pressure on the driver while turning it in a clockwise direction until the screw point

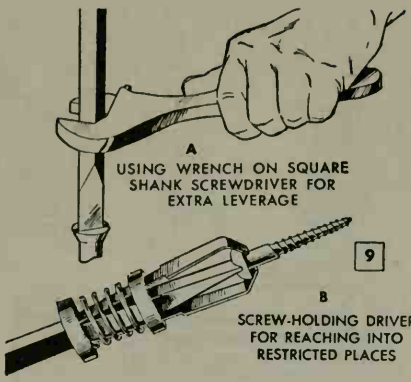


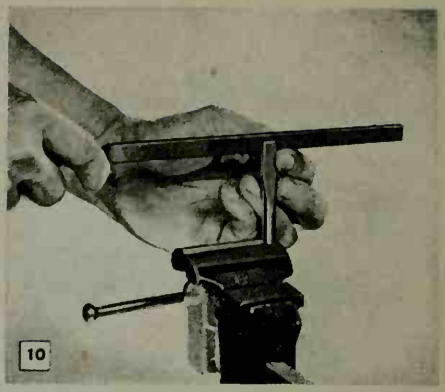




engages the wood. As soon as the screw holds firmly, transfer your fingers to the screwdriver blade, letting it slip between them to keep the tip centrally on the screw shank. Apply just enough pressure on the driver to keep it in the slot, and hold the driver blade directly in line with the screw, Fig. 7. Tilting the driver when starting a screw causes it to go in at an angle, while tilting it after the screw is fully engaged may cause the driver to slip out of the slot. When cross-slot drivers are tilted, one of the wings is likely to break off because of unequal pressure. The handle of a good screwdriver is rounded and smooth at the end (dome) to provide a comfortable palm rest, and the stopped flutes have rounded edges to minimize irritation and skin abrasion, Fig. 7.

Types of screwdrivers: Three regular screwdrivers in the sizes shown in Fig. 8, A, are a good selection for the home tool kit. In addition there will be occasional need for two sizes of cross-slot drivers, detail B. To avoid duplicating sizes in each type, you can obtain drivers having reversible blades with a different type tip at each end, detail C, Fig. 8. For cramped quarters use either a "stubby" driver, D, or an offset driver, E. Stubby drivers have short handles and are made with both light and heavy-duty tips. Offset drivers (regular, cross-slot or combination tip) usually come in four sizes and also can be obtained in the ratchet type, detail F. Where considerable work must be done in driving or loosening screws, you can save time and effort by using a spiral driver, Fig. 6, which merely requires pushing down on the handle to turn the blade in either direction, according to the setting of the ratchet control. It also can be locked for use like an ordinary driver. Be sure to push the spiral driver slowly while holding the screw for starting, using light pressure until the screw is firmly engaged. Some spiral drivers have hollow handles in which interchangeable screwdriver bits of different sizes or styles are kept at hand. The assortment also may include drill bits of various sizes. Ratchet drivers, Fig. 8, H, have handles that turn the blade in either direction by ratchet action. The ratchet can be disengaged by moving the slide to the center position. When turning in large screws, a driver of the type made to fit a bit brace often is used, detail G. Because of the increased leverage of the brace, it is important to use a driver of the correct size. Avoid using the full leverage to loosen tight screws or to drive those not provided with adequate pilot or shank holes as the heads may break. An-





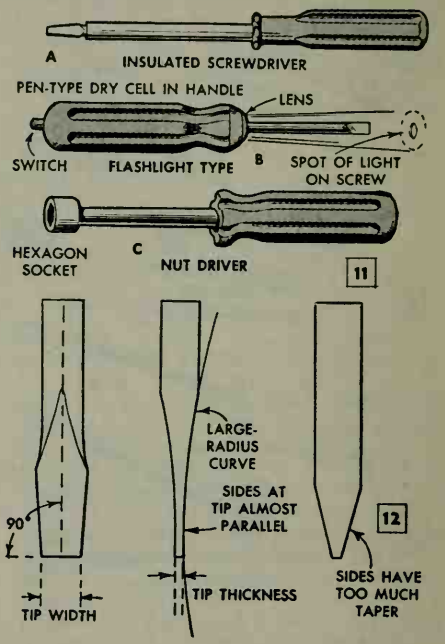
Some illustrations courtesy of Vaco Products Company

other way to obtain extra leverage is to use a wrench on a square-shank driver, Fig. 9, A. When screws must be driven in places inaccessible to the hand, use a screw-holding driver, Fig. 9, B.

Drivers having insulated blades, Fig. 11, A, are used by electricians and radio and TV servicemen. If a nonmagnetic driver is required, use one having a beryllium-copper blade. Flashlight drivers, detail B, illuminate the heads of screws hidden in shadows. Nut drivers, detail C, Fig. 11, come in various sizes. They are similar to screwdrivers but have hexagon sockets for use on hex nuts.

Misuse of screwdriver: Screwdrivers can be damaged quickly by prying, by scraping and by hammering on the handle. The tip of a good driver is heat-treated to the correct degree of hardness and toughness to resist wear and strains of normal use. Don't use a good driver to short across the terminals of a storage battery as the heat may draw the temper of the blade. Using the driver for such jobs as scraping loose mortar from brickwork will round the sharp corners of the tip, causing it to slip out of the screw slot.

Tip maintenance: When driver tips become worn, bent or chipped, they should be reground to the correct size and shape. This can be done by grinding and then dressing with a file, as in Fig. 10. Be careful to retain the original taper, width and thickness of the tip. It should be straight and at right angles to the axis of the blade, as in Fig. 12. The sides of the blade near the end should be almost parallel so that the driving torque is transmitted to the sides of the screw slot uniformly. Too much taper will prevent the tip from reaching the bottom of the slot. Too thin a tip will bend or break. When restoring the tip by grinding,

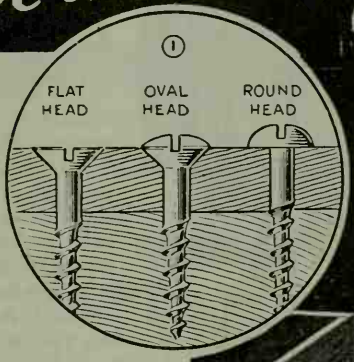


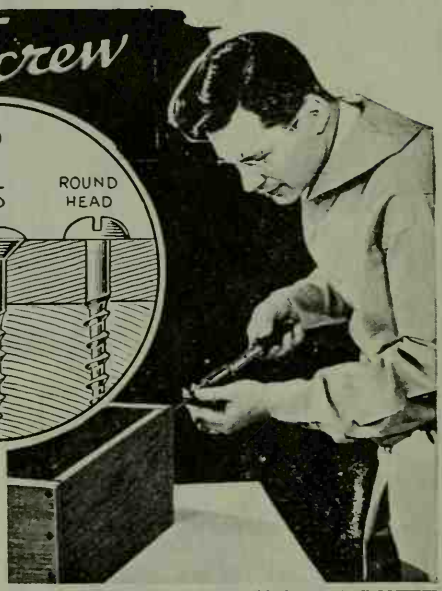
touch the wheel lightly in short passes to avoid overheating the metal. Also dip the blade in water while grinding. Screwdrivers are available with variations of both the cabinetmaker's tip and the keystone tip, as shown in the detail at the right of Fig. 1. The cabinetmaker's tip has parallel sides so that the driver will follow the screw into a deep counterbored hole without binding or otherwise damaging the wood. Variations of this tip are supplied for fine work on typewriters, instruments and light machine assembly. These tips are cross-ground on a coarse wheel to provide a sure grip in the screw slot. In cross-grinding, be careful not to increase the taper.

SCREW DRIVING

To Drive a Screw

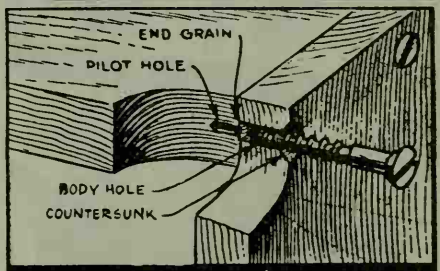
Little tricks and proper procedure will make screws hold effectively



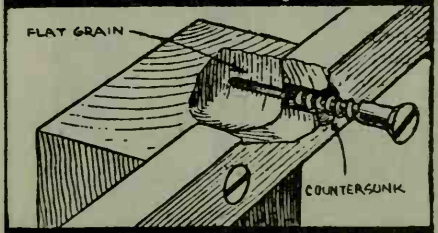


UNLIKE glue or bolts as a means of joining parts made of wood, the holding power of a screw depends on the resistance of the wood structure to tearing or pulling strains. When being driven, a wood screw taps its own thread and relatively little of its power to hold parts together depends on the wedging pressure of the wood fibers, as is true with a nail.

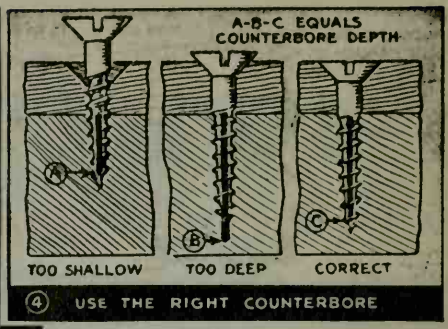
In joining any wooden pieces it is necessary first to consider the type, size, number and length of the screws to be used. Fig. 1 shows the three types in most common use, any one style being made in a variety of sizes and lengths. After selecting the desired length, you take into account whether the assembly requires that the threaded section of the screw is to be driven into end grain, edge grain or flat grain, Figs. 2 and 3. Edge and flat grain are about equal in respect to the holding power of screws in most common woods with the exception of knots or other defects at the point where the screw is to be driven. When screws are driven into end grain, the smaller diameter of the counterbore or body hole for the screw, is really a pilot hole and should be drilled only deep enough to start the threads, Fig. 2. In the common softer woods the threads will cut their way into end grain without the ne-



② ... into end grain

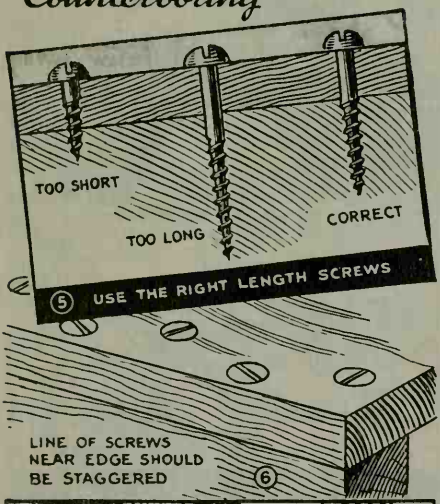


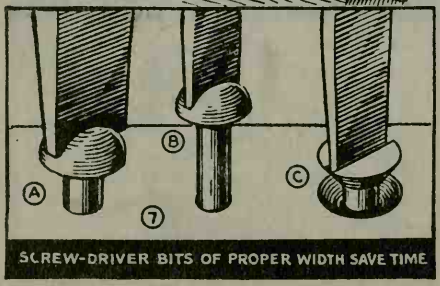
③ ... into flat grain



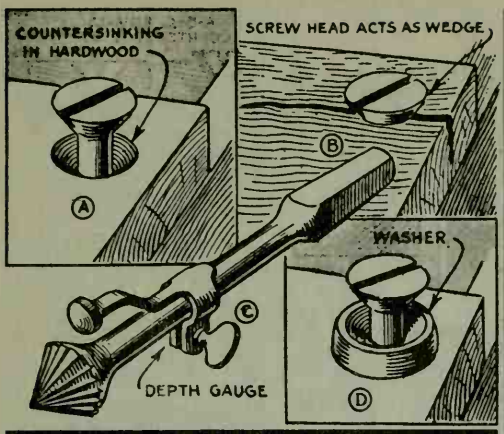
Counterboring

cessity of counterboring for a greater length of the threaded section. The only exceptions to this are the very hard, close-grained woods such as "rock" maple. In end grain the wood fibers lie parallel or nearly so to the axis of the screw and those directly in the path of the screw are either severed or forced aside. When driving screws into flat grain of hard close-grained woods, the small diameter of the counterbore should be just slightly less in depth than the length of the threaded section of the screw as in detail C of Fig. 4. If the counterbore is too shallow in hardwood as in detail A, the undue twisting strain necessary to drive the screw may break it. On the other hand if the counterbore is too large or too deep as in detail B, the threads may pull loose before the countersunk head of the screw is seated flush. In hardwood, the diameter of the counterbore should be the same or a trifle larger than the body of the screw measured at the bottom of the threads, while in softwoods the diameter of the counterbore should be smaller in most cases.

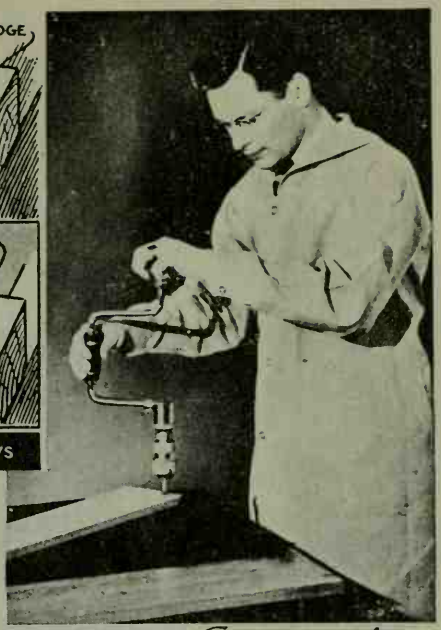




To say that a screw is too long does not imply that its effectiveness is lessened, but means that there is little point in using a screw longer than necessary. An example is shown in the center detail in Fig. 5. In the detail at the left the screw is obviously too short to hold the parts together while a screw of the proper length as in the extreme right-hand detail, will result in a joint of maximum strength. When you drive a line of flat-head screws near the edge of the stock it's generally best to stagger them as in Fig. 6. Using a screwdriver bit of the proper width is also important. See Fig. 7. In detail A the wide bit is likely to twist out of the slot. Details B and C show bits of the correct size and



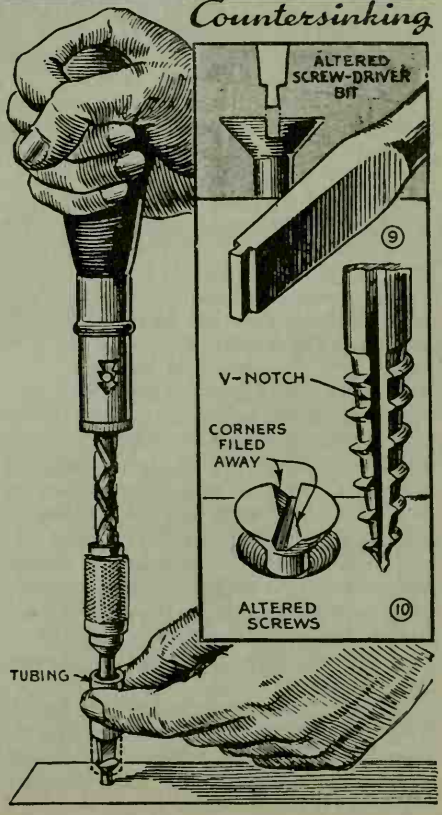
⑧ COUNTERSINK HOLES FOR FLAT-HEAD SCREWS



width for the size and type of screw. Countersinking flat-head screws to the proper depth in hardwoods is shown in detail A of Fig. 8. Countersinking to a diameter less than the head of the screw as in detail B sometimes results in splitting the wood. Use a depth gauge on the countersink as in detail C. A metal countersunk washer of the kind shown in detail D may be used with either a flat or oval-head screw to prevent splitting where the screw must be driven close to the edge of thin stock.

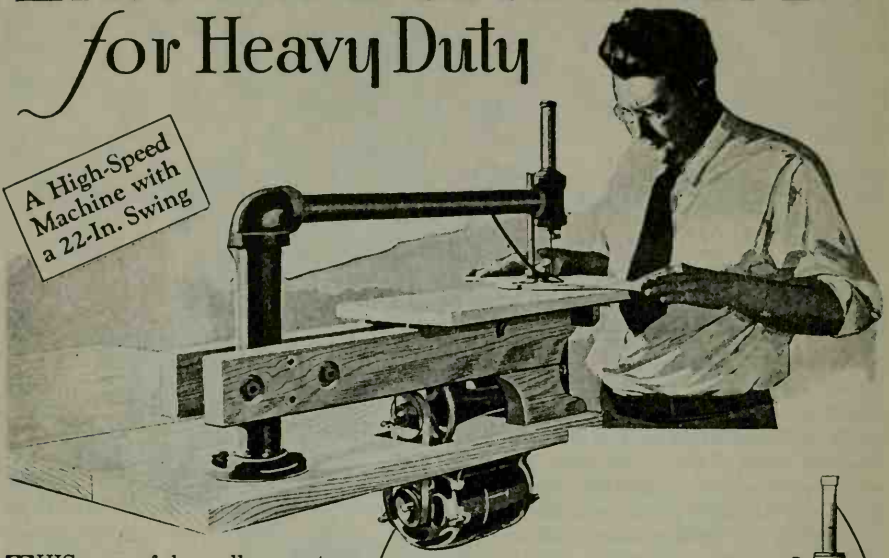
Grinding reverse bevels on the screwdriver bit as in Fig. 9 will help to give larger bits a better "bite." Fig. 10 shows one way of filing the screw slot to prevent the screw being turned out. Sometimes this is desirable, as on door hasps. Another kink that helps when driving screws into very hard woods or hard fiber is shown in the right-hand detail of Fig. 10. Filing a V-slot along the length of the screw causes the threads to cut through the hard material much like a tap. When driving a large number of screws of the same size you will find that a short piece of tubing slipped over the head of the screw prevents the screwdriver bit from sliding out of the slot. Using a little soap on screw threads should also be kept in mind as this helps to reduce friction.

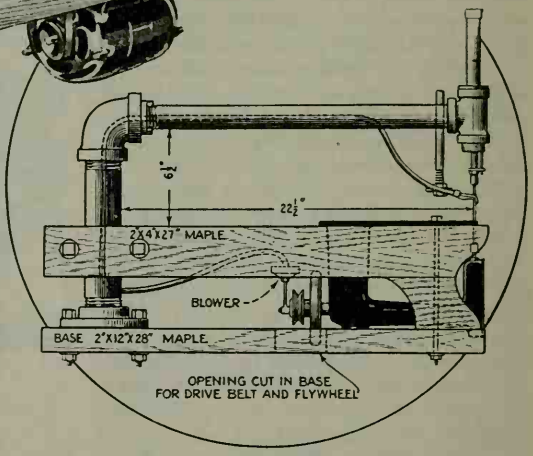
Countersinking



Efficient SCROLLSAW *for* Heavy Duty

A High-Speed Machine with a 22-In. Swing

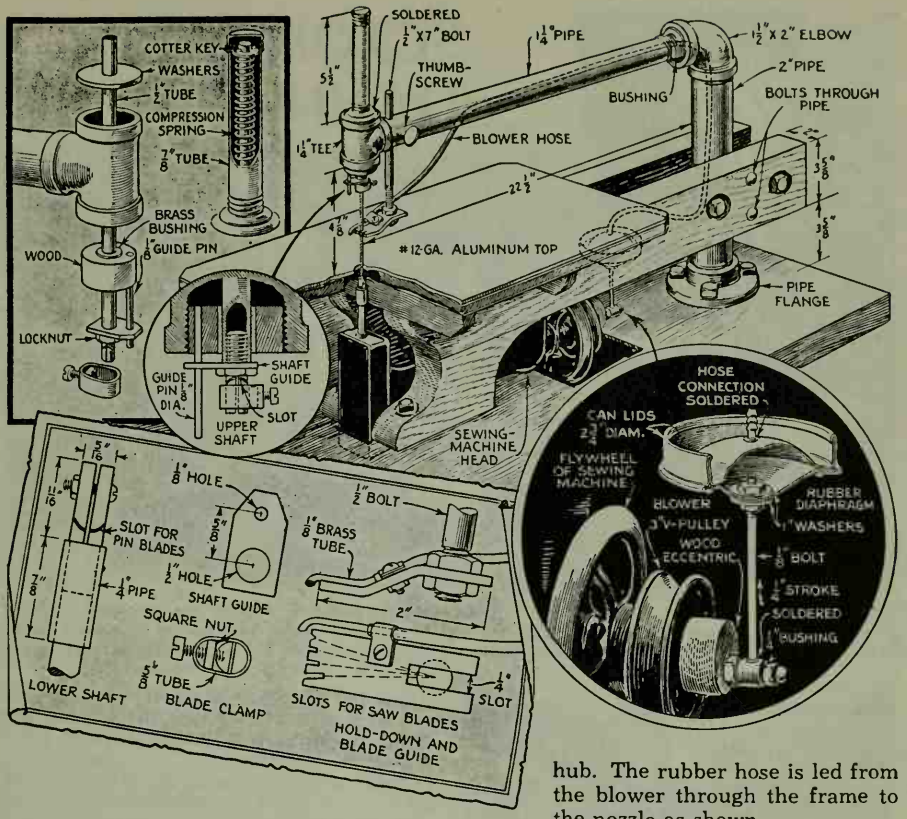




THIS powerful scrollsaw cuts 1½-in. stock with ease at 1,400 strokes per minute, and is designed to be used with either the heavy saber-type of blades or the finest jewelers' blades. If you have an old sewing-machine head and a ¼-hp. motor, the total cost should not exceed $5.

The sewing-machine head is adapted to its new use by first removing the needle shaft and holder and substituting a blade holder. The head is then inverted and securely bolted between two lengths of 2 by 4-in. maple which are supported on two hardwood blocks bolted either to a separate base or directly to the bench top. Due to variations in the size and needle stroke of different types of sewing-machine heads, slight alterations may be found necessary when assembling, and for this reason some of the dimensions have been omitted as they depend on the particular installation you will use.

Pipe and fittings are used for the frame. When assembling it, the joints should be turned in as tightly as possible. The flange is securely bolted to the base. A saw table of ⅞-in. hardwood is made to fit over and around the base of the sewing-machine head. It is covered with a 10 by 20-in. plate of No. 12-gauge aluminum. A ½-in. hole is drilled in the plate to form an opening for the blade. The upper slide shaft, or plunger, is made from a 9-in. length of ½-in. seamless-steel or brass tubing. The lower end is bushed with a piece of brass tubing soldered in place and tapped to take a 1½-in. length of ⅜-in. bolt. The shaft guide is then drilled as shown. It is held against the end of the tubing with a thin nut. A wooden disk.



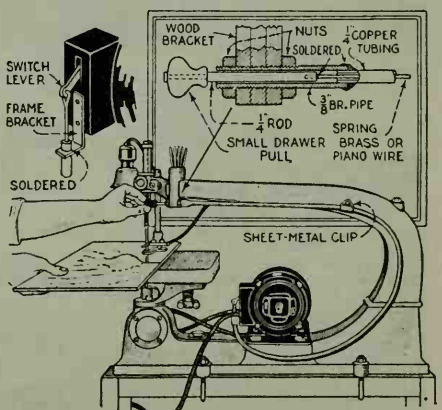
hub. The rubber hose is led from the blower through the frame to the nozzle as shown.

bushed with brass to fit the plunger, carries the lower end of the latter and also the metal guide pin which prevents the plunger from turning. The wooden disk is turned into the lower end of the pipe tee.

Other details of the upper-plunger assembly are shown in the drawing.

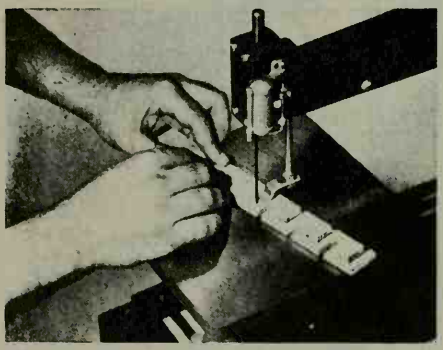
The combination blade guide and hold-down is made by first sawing the head from a ½ by 8-in. carriage bolt and filing two ⅛-in. grooves in the threaded end at right angles to the length. The end of the hold-down is slotted to fit the grooves and is held with two nuts as shown. Narrow slots are filed in the opposite end of the hold-down to serve as guide slots for the various sizes of blades. The blower nozzle is formed by bending a short length of ⅛-in. tubing to an elbow. A blower is easily made from tin-can lids and is driven by means of a wooden eccentric attached to the outer end of the V-pulley

Motor-Switch Control on Scroll Saw Located Above Table

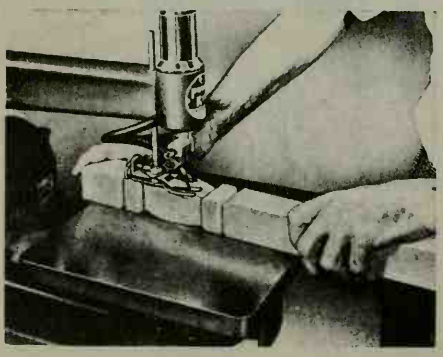


SCROLLSAW TECHNIQUES

That's right! Crafting is fun when you have a good scrollsaw, or jigsaw, such as the one pictured above. This machine runs smoothly, makes very little noise, and it's the safest and easiest to operate of all the sawing machines. Many experienced craftsmen place it at the top of the list of first machines to buy

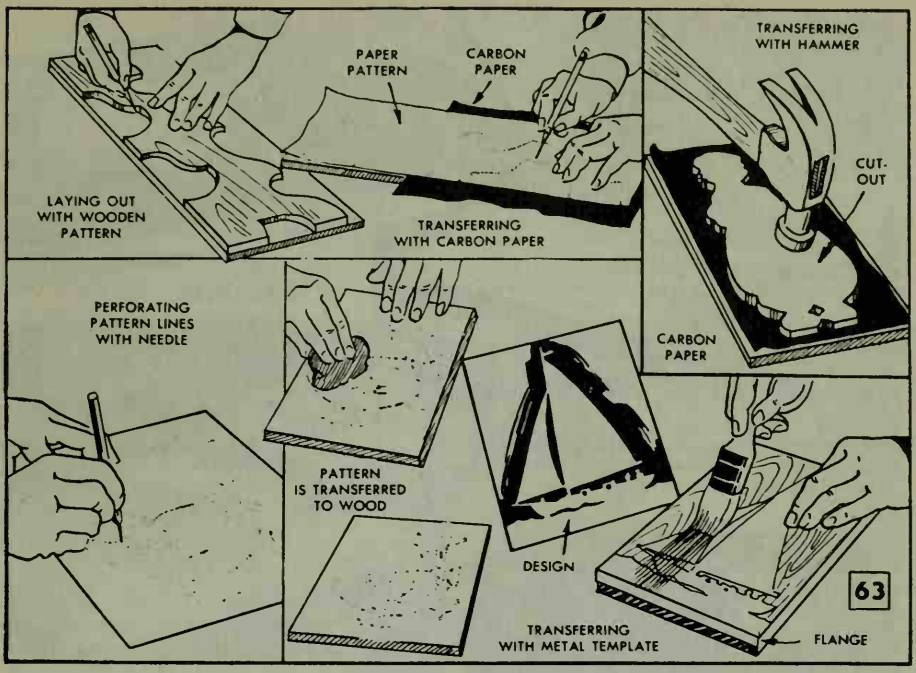


Above and below, the size range of work that can be handled on a scrollsaw includes much cabinet work



YOUR SCROLLSAW, also called a jigsaw, is not only the safest power machine in the shop, it's also especially adapted to the novelty crafts such as inlay pictures, picture puzzles, pattern cutouts, letter inlays and all manner of intricate fretwork sawing where the patterns are cut through without cutting in from the edges of the stock. Many crafters with special leanings toward novelty work give the scrollsaw first choice among small power tools. It is quite true that you can handle a lot of ordinary cabinet work, such as straight and bevel ripping, sawing tenons and certain table-leg shapes such as that pictured in the lower left-hand photo on this page, and any scroll-cut designs for cabinet ornament which come within the capacity of the machine. Most of the larger machines of 24-in. swing (distance from blade to frame) are so constructed that the upper arm can be removed and the machine used with saber blades for cutting large plywood panels. The saber blades operate without any top support such as is required by the finer scroll blades.

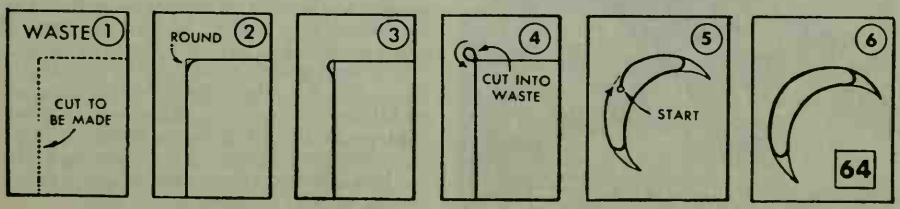
Sawing from pattern layout: A typical scrollsaw job is that of making cutouts. The details in Fig. 63 show how the cutout patterns are transferred to the stock. First you must have a full-sized paper pattern of the cutout. In some types of work the pattern can be mounted directly on the wood. Otherwise the pattern outlines are transferred

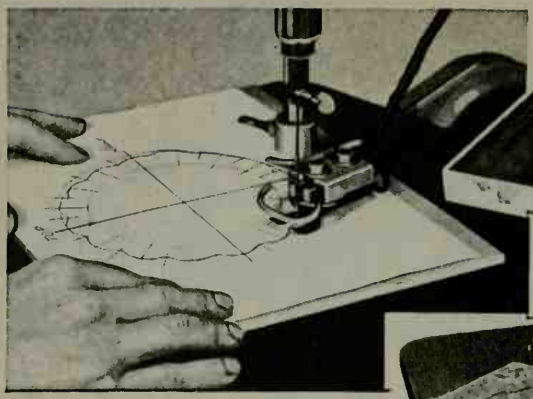


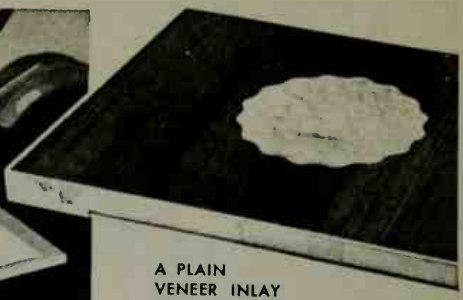
Above are detailed processes of producing intricate scrolled work by the transfer of patterns to provide guide lines on the work. The whole thing is quite simple to do once one gets the process in mind. Wood patterns (cutouts), carbon-paper transfers and perforated-paper patterns are commonly used

to the stock with carbon paper, as in the details in Fig. 63. However, if a number of duplicate pieces are to be scrollsawed, the carbon-transfer method is too slow. A speedier transfer method must be used, such as the perforated-pattern procedure. The perforated pattern is made by penciling the design on a sheet of durable paper and then going over the pattern lines with a needle, making perforations spaced about 1/16 in. apart. The pattern is then located on the stock, held in place with tape and rubbed lightly with transfer ink or asphaltum paint. Still another production method is the use of a thin metal template fitted with a flange so that it is quickly located. Then the template and a part of the area around the edges are "painted" with dry graphite. This method produces a reverse outline such as is shown in one of the

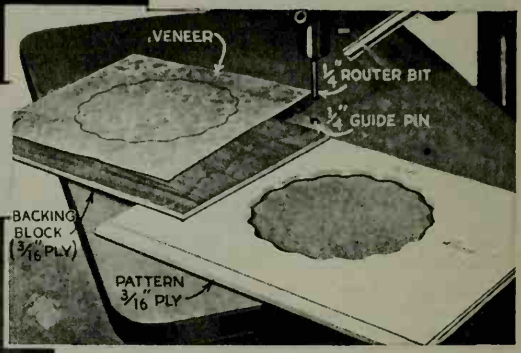
Here's a jigsaw with the blade turned at right angles (most small machines have this feature) and ripping a piece of long stock. The operator works freehand to a guide line rather than using a rip fence

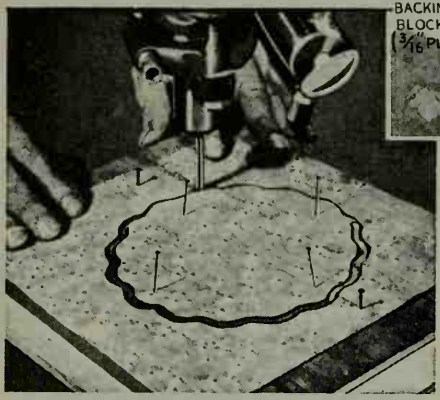






VENEER INLAYS are cut from solid veneer of contrasting color. One pattern is used for cutting both the inlay and the recess

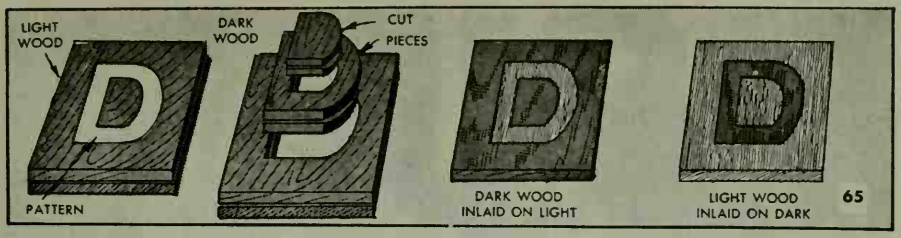




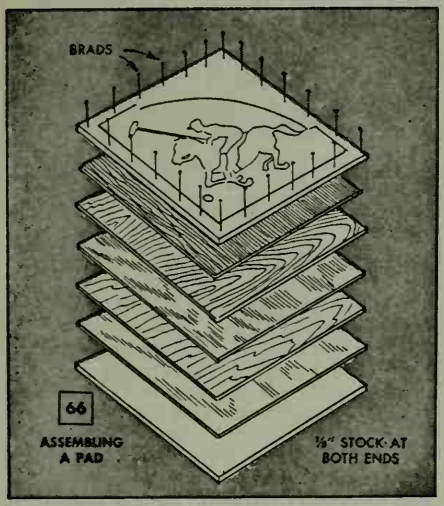
Above and below, the router is frequently used in connection with intricate scrollsaw work. The router pictured below is working inside a speciol template

samples. Patterns or profiles for transferring can be made by the familiar method of laying out on squared paper, using as samples your own original drawings, clippings and, in some cases, photographs. Large selections of cutouts which are easily traced, or transferred to the stock, are available from manufacturers of homeshop power tools and from dealers in plans.

Making inlay pictures and veneer inlays with a scrollsaw is done by a process known as pad sawing. This procedure is well illustrated by the four progressive steps shown in the detail, Fig. 65. Any design cut out of the pad—first detail at the left—can be reassembled as in the second and third details to produce the result shown in the fourth detail. That's the principle; the figures below show how it works out with a typical project, a book end with a polo-player design. Here the pattern is first transferred to ⅛-in. plywood. A second piece of plywood of the same thickness is cut for the bottom of the built-up pad, Fig. 66. Veneers of various kinds and colors of wood are stacked between the top and bottom pieces, which are bradded together to make the pad. Then the pad is scrollsawed on all the pattern lines. When all the separate parts resulting from these cuts are fitted together and glued to a suitable backing you get the picture shown in the photo of the completed project.

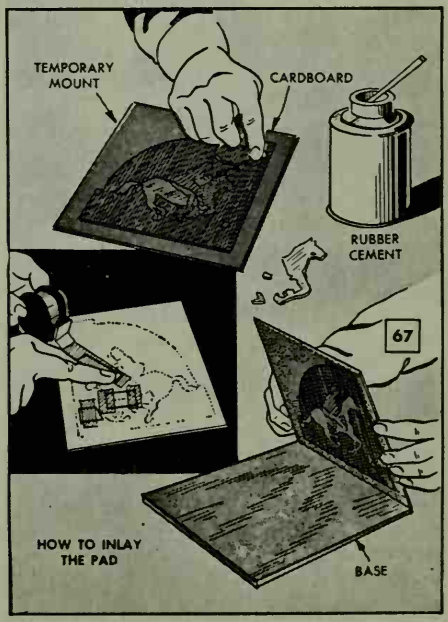


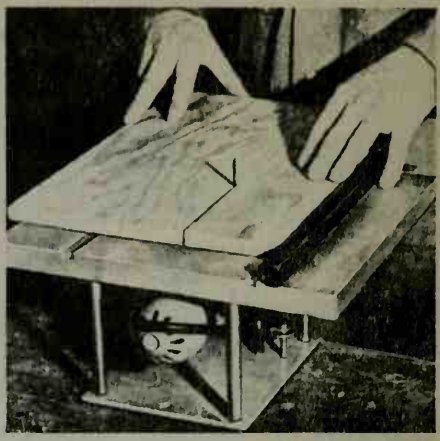
The four details above show the process of inlaying o letter by scrollsawing, using contrasting woods. The same procedure can be used in inlaying designs of olmost any irregular shape and with very little waste



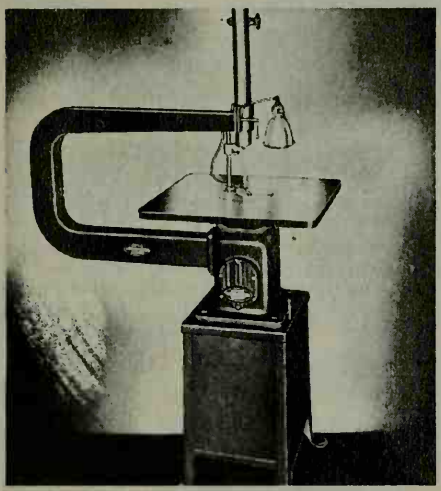
Detail at the left shows how to make a stack, or pad, of varicolored veneers which turns out the inlay picture at the right when the pattern is sawed through

Veneer inlays: Photos, earlier pg., show how veneer inlays are made. One pattern is used for laying out both the inlay piece and the recess. The recess is routed to depth on the drill press as in the center left-hand photo on the preceding page. The lower left-hand photo pictures another method, using an electric router working in a template. This machine can be used in connection with the scrollsaw for a variety of delicate inlay work with veneers. Beautiful two-tone work in woods of pleasing contrast is possible by using this method of inlaying. It is especially effective on drawer fronts, on cabinet doors and on ornamental box tops. Such combinations of woods as bird's-eye maple and walnut, bird's-eye maple and mahogany, and curly maple or fiddle-back maple and rosewood are the sharp-contrast combinations. East Indian satinwood and any of the lighter burls finished in the natural color make a pleasing soft-contrast combination. Generally such inlays are combined with narrow inlaid borders or veining in contrasting woods. The electric router pictured is the tool for routing the recesses, or grooves, for





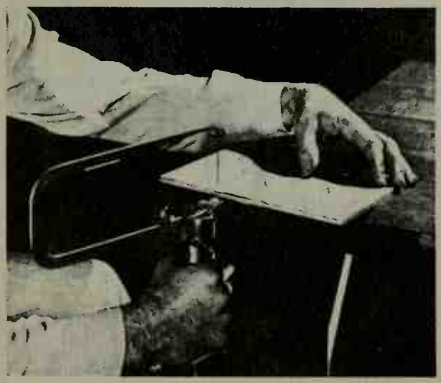
Here's something new in scrollsaws — a portable self-contained unit that's really speedy on scroll-work of an open design. Turn it over and bolt to the table shown at the right and you have a saber saw

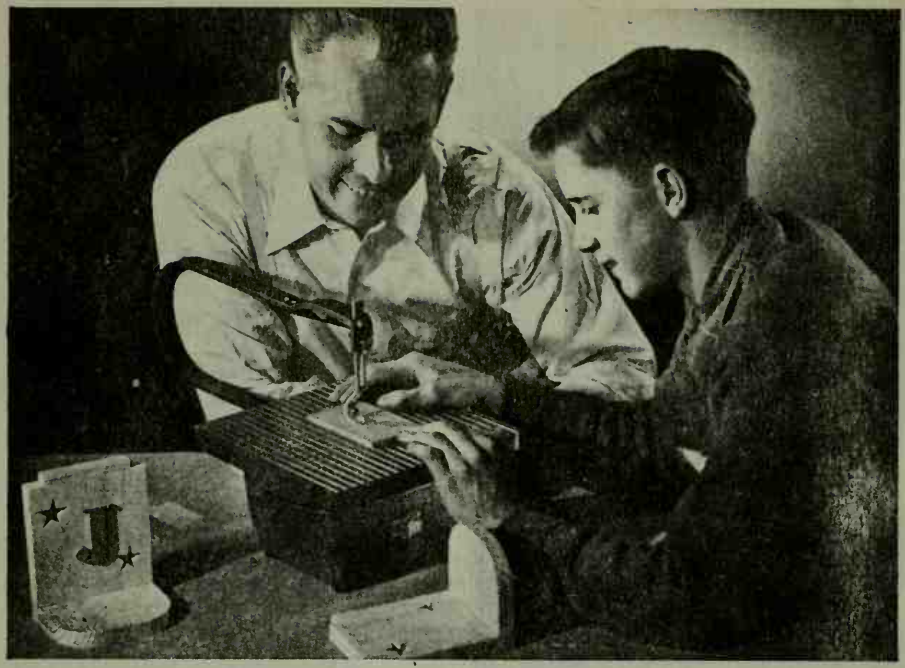


inlay borders or veining-strip inlay. The machine is supplied with a detachable guide which is adjustable for distance from the edge of the stock. The guide will follow either a straight or curved edge with equal facility. Router bits are available in a wide range of sizes from 1/16 in. up, in addition to various molding-cutter shapes for molding edges. Now, refer back to Fig. 64 which details general technique applying to all scrollsaw work. Left to right, the first four details show ways of cutting past a right-angle corner in the layout, the object being to produce a square corner on the work. You can turn a narrow blade, leaving only a slight radius. With a wider blade you can run outside the pattern line and then come back at a right angle, as in the third detail. The bulge is later smoothed by sanding. The best method is to loop the cut into the waste as in the fourth detail. This procedure produces a square corner.

Pictured above and below are the big and little in scrollsaws. Machine above is heaviest bench type

Don't forget that your scrollsaw also handles metal cutting, too. Here's one cutting an intricate pattern

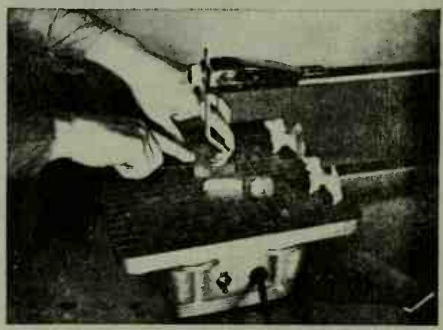




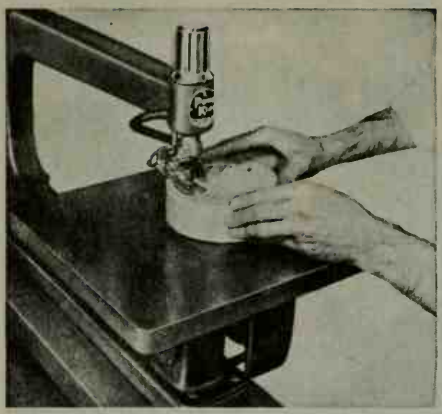
Principal feature of this magnetic, or vibrator-type, scrollsaw is the extremely high speed of the blade, more than 12,000 strokes per minute. This high speed leaves a gloss-smooth surface requiring no sanding. Although it will handle softwoods up to ½ in. thick, it's best for making cutouts as shown in photo below

The fifth and sixth details show how to start an inside cut in the waste.

Portable scrollsaw: Shown previously is something comparatively new in scrollsaws. It does the work of a scrollsaw, bandsaw and saber saw all in one unit The table shown in the right-hand photo is furnished as an accessory. Due to the comparatively heavy, stiff blade, extremely intricate scrollwork cannot be done, of course, and the short length of the blade limits the depth of cut. In this it cannot, of course, be compared with either the bandsaw or scrollsaw. The short blade is driven at high speed and on long-radius work it cuts very smoothly. The center photo , earlier pg., illustrates a larger, heavier scrollsaw than any of those shown heretofore. It has a 20 x 20-in. table, uses longer blades than the conventional sizes, and swings 24 in. between the blade and frame. The frame is detachable for saber sawing. This is the largest machine practical for homeshop use. Now, going from the large to the small, the lower left-hand photo shows a "motorized" coping saw which is a practical tool for scrollsawing small parts such as those found on scale models. The blade is driven at very high speeds by a vibrating coil housed in the handle and controlled by



a trigger switch. Due to the extremely high speed of the blade it leaves the sawed edges glass-smooth, thus eliminating sanding to remove saw marks. At the lower right, previous pg., you see a scroll saw being used in making a metal cutout. It is necessary to use metal-cutting blades for this work, also the speed must be reduced to avoid heating of the blade and work. In the photos above a conventional type of scrollsaw having a vibrating-coil drive is shown in use. This machine has the same characteristics as the hand-held unit already described, but is larger and more powerful.



A conventional-type scrollsaw making the inside cut necessary in forming a solid ring. Cut is started by passing the blade through a hole drilled in the work

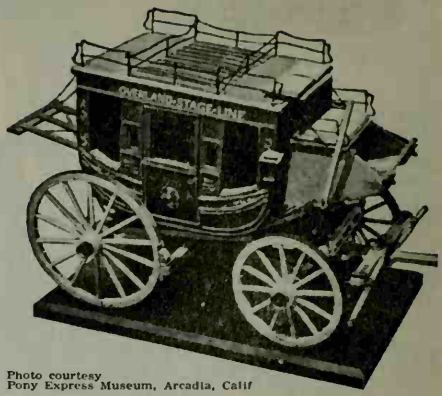
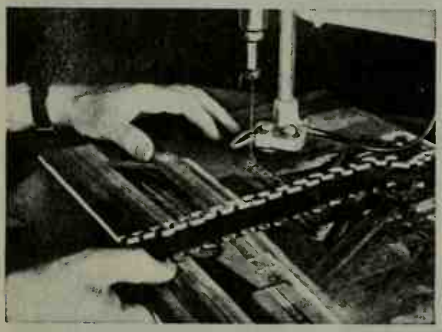


Photo courtesy
Pony Express Museum, Arcadia, Calif

This kind of a model job is made to order for a scrollsaw. Of course, you can use a bandsaw with narrow blade, but the scrollsaw would be modelmaker's choice



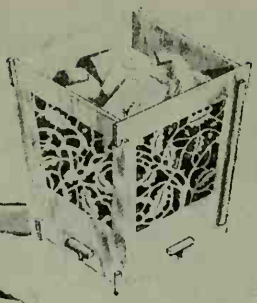
It's easy to guess that this is going to turn out to be a jigsaw puzzle, and from the looks of the intricate job, it's going to take some doing to put it together

The fine blade leaves the edges of the work so very smooth that no finish sanding is required. It is especially adapted to intricate curved sawing. Another special feature of this machine is that the frame is adjustable to the offset position shown, so that long ripping cuts can be made without interference from the frame. It should be kept in mind that machines driven by vibrating coils are suitable only for light work and do not supplant the heavier-type machines.

Now, after this briefing on bandsaw and scrollsaw operation, you'll be able to see a lot of uses for both types of power tools on the stage-coach model pictured above. A big share of the parts of both the body and the running gear are bandsaw or scrollsaw jobs.

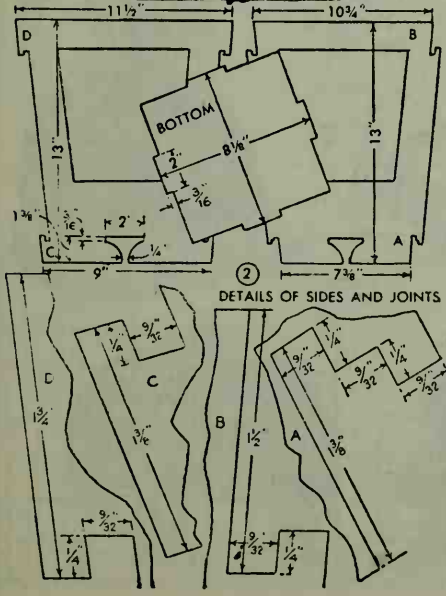
SCROLLSAW BLADES

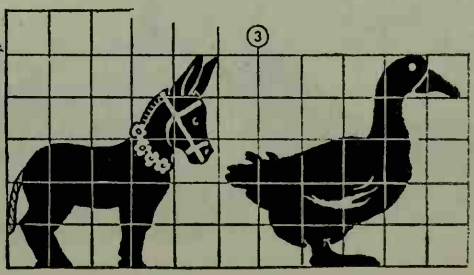
Material or Operation	*General Features of Blade*	*Operating Speed (r.p.m.)*
HARDWOOD 3/4-in. stock	Medium temper, set teeth. Not over 15 teeth per in.	1000 to 1750
HARDWOOD 1/4-in. stock	Medium temper. Teeth need not be set.	1750
SOFTWOOD 3/4-in. stock	Medium temper, set or wide-spaced teeth. Not over 10 teeth per in.	1750
SOFTWOOD 1/4-in. stock	Teeth need not be tempered or set	1300 to 1750
PUZZLES, INLAYS, MARQUETRY	Not tempered; not set. Blade must be thin.	1300 to 1750
SOFT METALS (over 1/8 in.)	Medium hard temper; set teeth.	650
SOFT METALS (under 1/8 in.)	Medium hard temper; set or not set.	650 to 1000
IRON AND STEEL	Hard temper, set teeth.	650
PLASTIC, BONE, IVORY (rough cut)	Medium temper, set teeth.	1000 to 1300
PLASTIC, BONE, IVORY (finish cut)	Medium temper, with or without set.	1000 to 1750

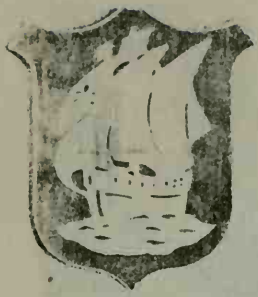


SCROLLWORK *for* EVERYBODY

MANY useful articles can be scrollsawed from scrap wood, metal or plastic for use around the home or for personal adornment. A profitable spare-time business might be built up from making and selling even one of the items shown here. Lapel pins, for instance, have a perpetual appeal, but when the pin is a scrollsawed photograph like that shown in Fig. 5 its sales appeal is almost irresistible! Also, wall plaques, picture frames, coat hangers and other articles of use around the home are greatly in demand. The waste basket, for example, not only answers an ever-present need in the library or den, but serves also as a decorative piece of home furnishing. And it is easily made. Five pieces of ¼-in. plywood or 3/16-in. hard-pressed board are cut to the patterns shown in the upper detail of Fig. 2 to form the sides and bottom of the basket. Two pieces are cut like the left-hand pattern, and two like the right-hand pattern. Note that the corners are different. These, shown in the lower de-





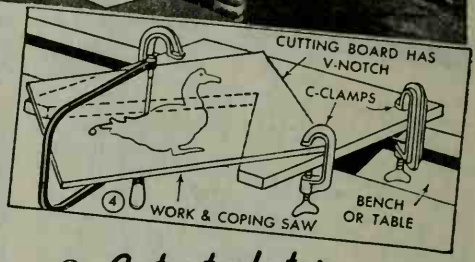


Anyone can develop a source of extra income from selling attractive scrollwork articles that are easy to cut from pieces of scrap wood, sheet plastic or metal

tails of Fig. 2, provide for interlocking the sides so that nails or screws need not be used. Next, a design like the one suggested in Fig. 1 is traced to the side pieces and scrollsawed. This work is done most easily with the aid of a V-notched cutting board, which is attached to the workbench with C-clamps, as shown in Fig. 4. In assembling the basket, put the sides together first, but do not press the corners tightly. Insert the bottom piece from the top, press it into place and then force the corners together firmly.

The animals, Fig. 3, which are scrollsawed from any suitable wood, make amusing gifts for children. They can be mounted on slotted boards, like the serviceman cutout in Fig. 5, and used in play barns or zoos. Or clasps can be cemented to them so that they become novelty brooches.

Scrollsaw work is especially applicable to picture frames. The center detail of Fig. 6 gives dimensions for a frame to take a 4 by 5-in. photo, but these measurements can be varied to accommodate larger photos. The lower right-hand detail shows how the frame, photo and a piece of cardboard are assembled and held in place by narrow wooden strips, which are glued or screwed to the back



⑤ Cutout photos

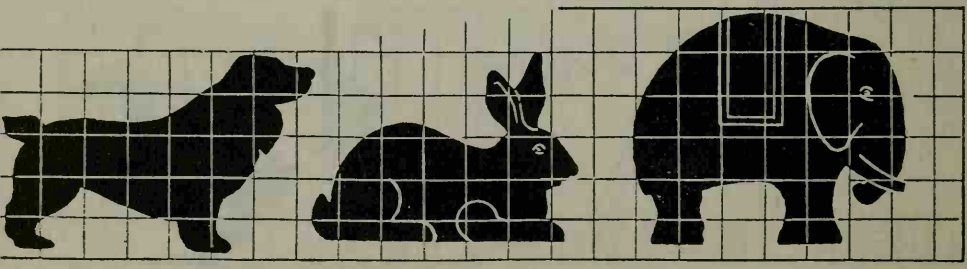
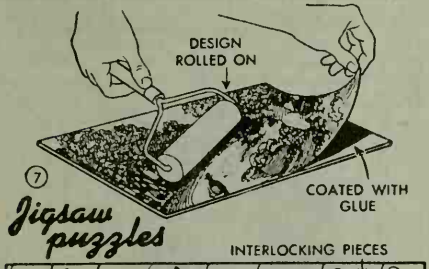
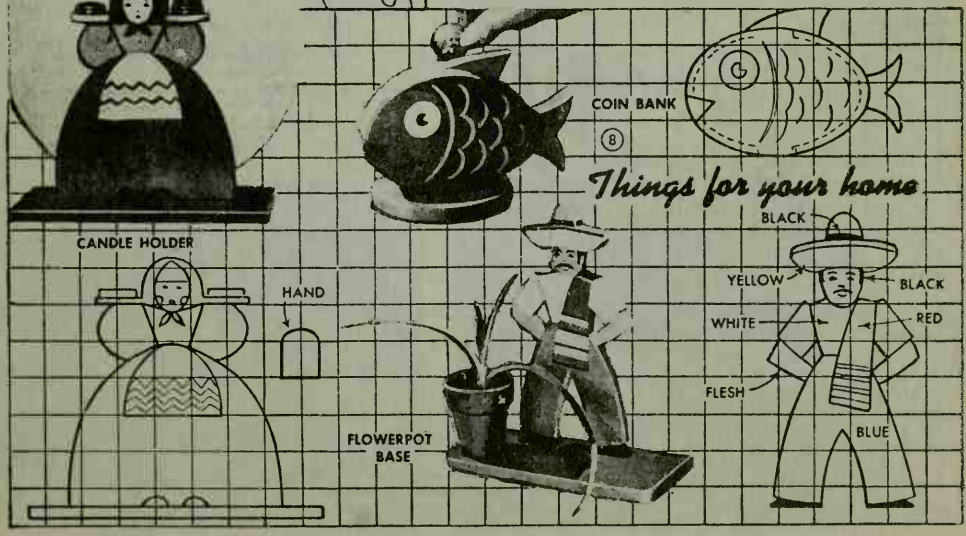
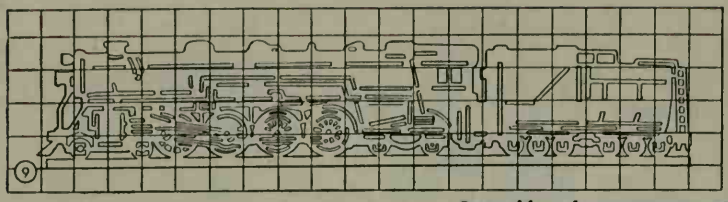


Photo courtesy United Service Organizations—Chicago



of the frame. If you like an easel-type frame, you can follow the plan shown in the upper right-hand detail, which shows how the support is hinged to the frame by means of a screw eye and pin. Jigsaw puzzles, too, are always popular. By making them yourself you can, of course, select the picture or design to form the puzzle pattern, and make the pieces as easy or as difficult to identify and assemble as you wish. Fig. 7 shows a design being rolled onto a piece of plywood that has been coated with glue. Wrinkles in the design paper must be smoothed out carefully before the glue dries, otherwise the picture will not cover the entire piece of backing. It is best to lay weights on the glued assembly to keep the paper tightly in contact and avoid wrinkles. When the glue has dried, the interlocking pieces can be scrollsawed, a pattern for these being shown





Wall plaques

in the lower detail of Fig. 7.

Several useful articles for your home are illustrated in Fig. 8. For the candle holder, scrollsaw the figure and brad it to a suitable base. Two feet, which can be made by splitting a disk cut from a piece of dowel, are glued in place as shown. The hands, which are glued to the ends of the arms, support rings that hold candles. The rings can be made by drilling a hole lengthwise through a short piece of dowel of suitable diameter, and cutting off the rings so formed. The coin bank consists of two sides, cut to shape as shown, two spacing strips and a base which is screwed to the spacing strips. The strips can be scrollsawed from a solid piece and are glued to the sides so that two slots are provided, the one on top for inserting coins, and the one on the bottom for removing them, which can be done only by taking out the screws holding the base. The flowerpot base is merely a length of wood or plastic to which a figure is attached. The toothbrush holder, door stop and clothes hangers are simple things usually much in demand. Though the wall plaques, Figs. 9 and 10, appear intricate, they are simply cut out of a single piece, then glued to a back, which may be a plain wood panel or one shaped like a shield.

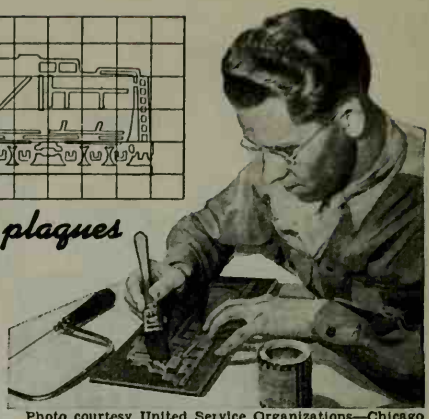
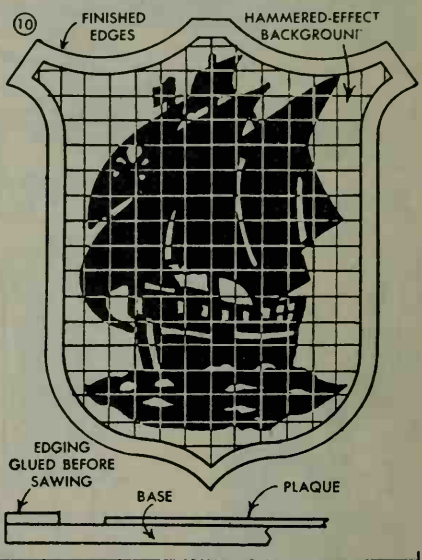
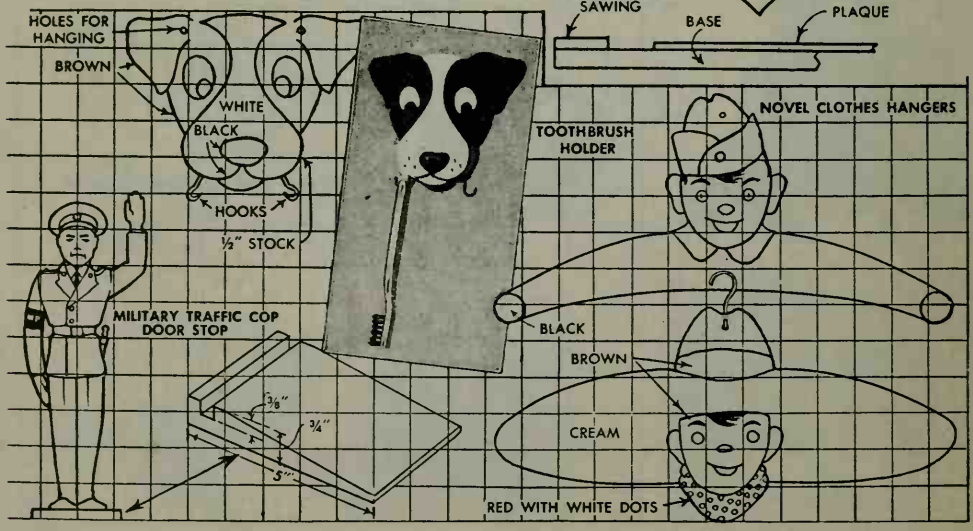


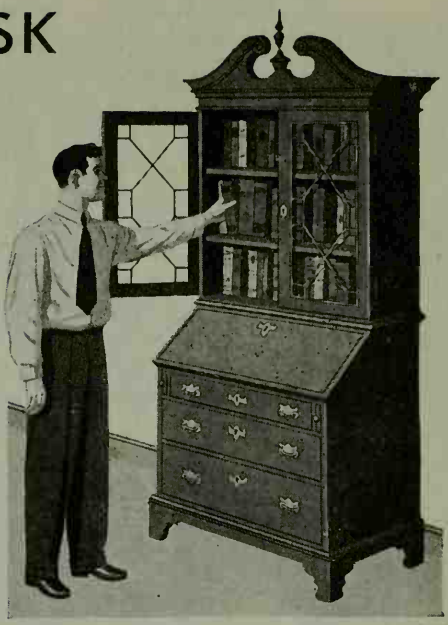
Photo courtesy United Service Organizations—Chicago

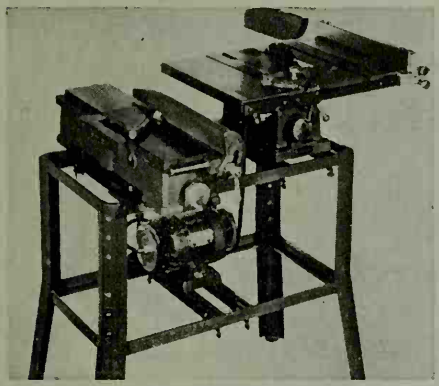




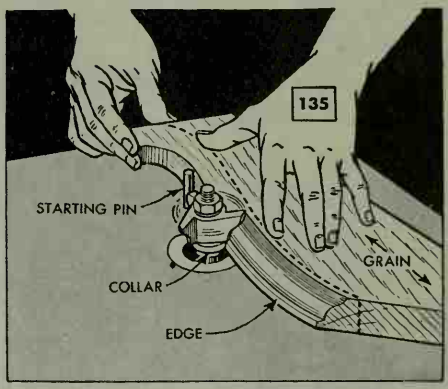
SECRETARY DESK

FOR BEAUTY of design, historical association, decorative value and all-around usefulness, a secretary desk is a top-ranking home-workshop project. It's going to take a lot of time to build one, even one on which the design details have been simplified, such as the type pictured and detailed on these two pages. But when you finish the job you have something of real value. Dovetailing the drawers, scrollsawing the plywood door grilles (from ¼-in. plywood) and running the cornice, or pediment mold, Fig. 135, are the only tricky jobs. Of course, you can use a rabbeted drawer joint, but the ordinary rabbeted joint is not in keeping with this type of cabinetwork. A router and dovetailing jig like that pictured in the photos at the bottom of the page turns out a perfect job. It cuts the sockets and pins in one pass, as in the left-hand photo, and the parts fit together as in the right-hand photo. The door grilles are a scrollsaw job, quite simple to do from the pattern. Note the 13 spaces in each grille. They symbolize the 13 original American colonies.

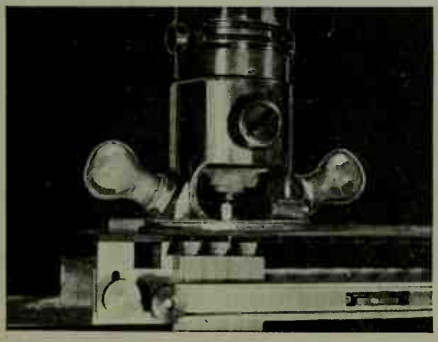


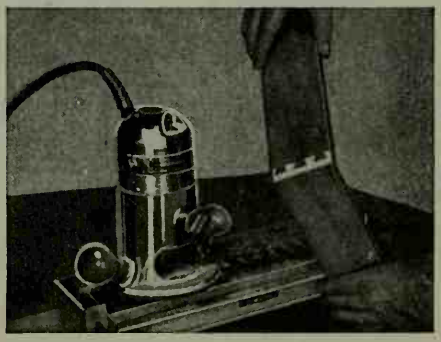


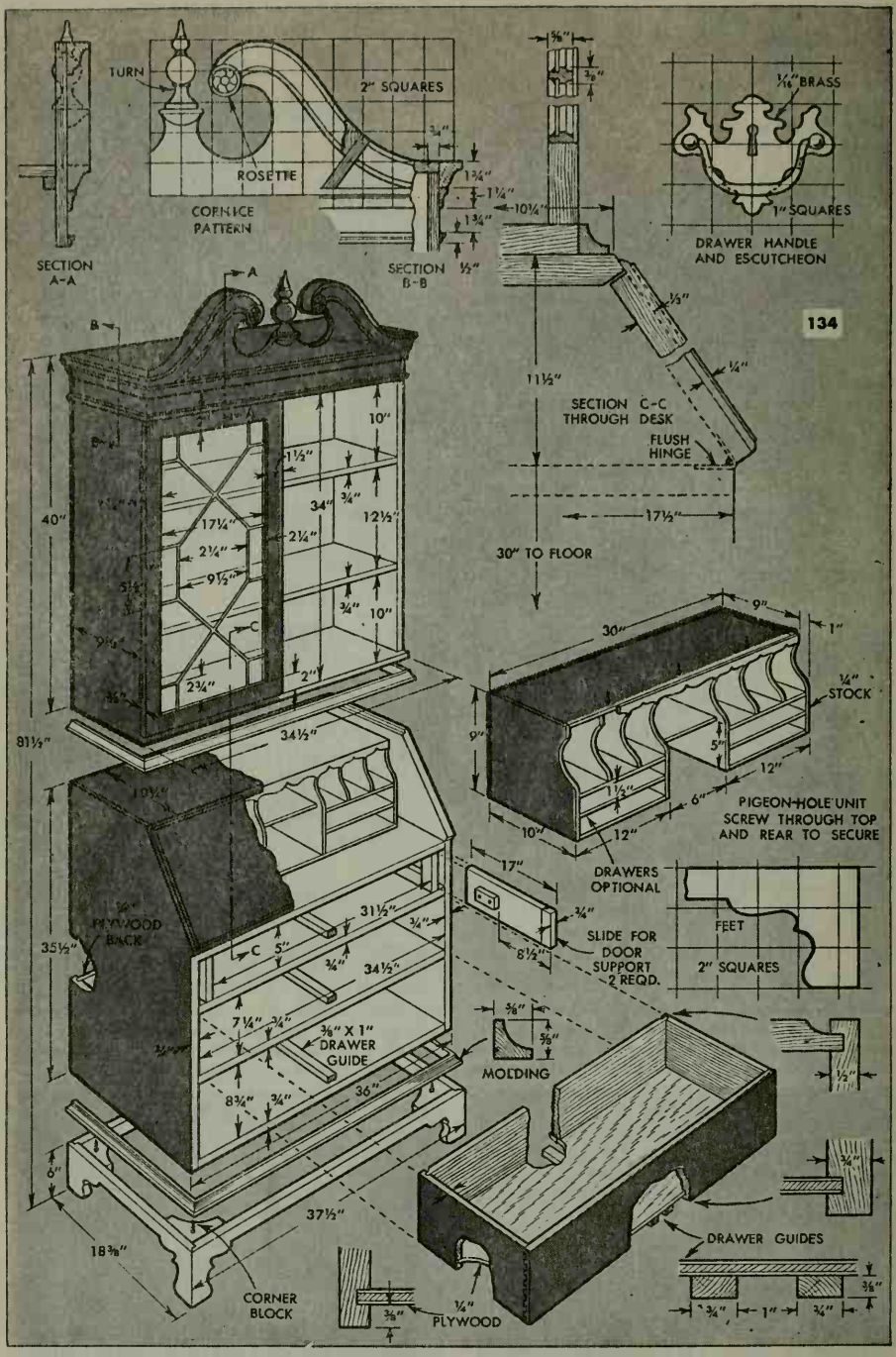
Above, for involved cabinet work a combination saw-jointer unit is handy in the small workshop. Below, dovetail joints are easy to make with the router and dovetail attachment. It makes a perfect join every time



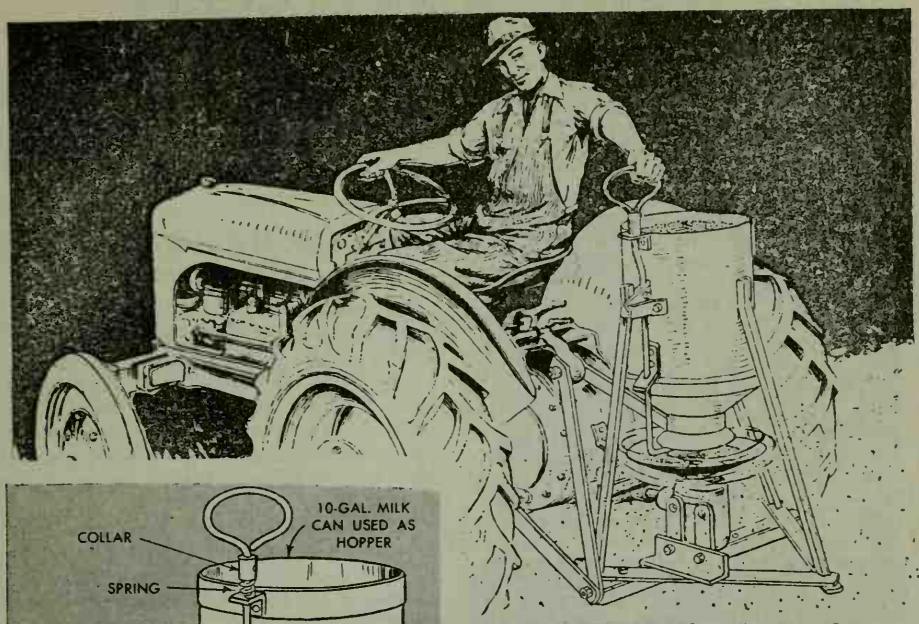
Above, cutting the cornice, or pediment, mold for the secretary desk. Note direction of grain. Below, a completed dovetail drawer joint made with the router and dovetail attachment. Note perfect spacing and fit

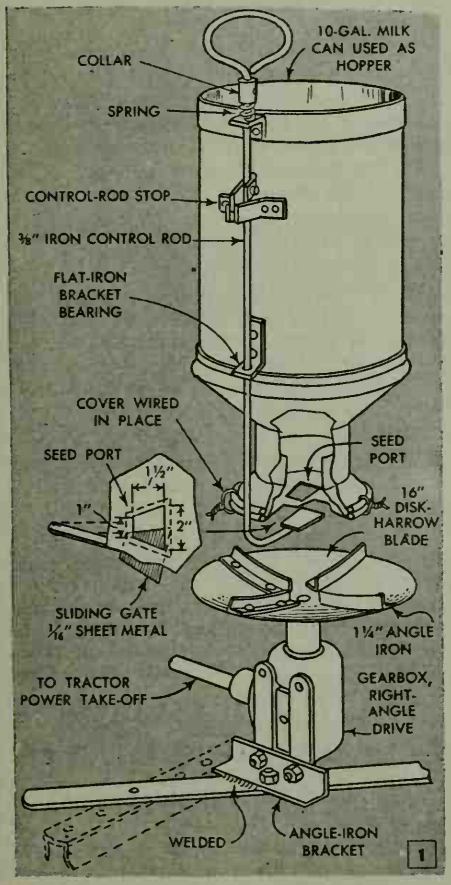





TURN
2" SQUARES
ROSETTE
CORNICE PATTERN
SECTION A-A
SECTION ½" B-B
⅛"
⅜"
10¼"
1¼"
1¾"
¾"
1/16" BRASS
1" SQUARES
DRAWER HANDLE AND ESCUTCHEON
134
⅓"
¼"
11½"
SECTION C-C THROUGH DESK
FLUSH HINGE
17½"
30" TO FLOOR
A
B
C
40"
10"
8"
1½"
34"
¾"
12½"
17¼"
2¼"
2¼"
9½"
5¼"
¾"
10"
2¾"
2"
3½"
81½"
34½"
19¾"
9"
30"
1"
¼" STOCK
5"
12"
1½"
6"
10"
12"
PIGEON-HOLE UNIT SCREW THROUGH TOP AND REAR TO SECURE
DRAWERS OPTIONAL
17"
¾"
8½"
SLIDE FOR DOOR SUPPORT 2 REQD.
FEET
2" SQUARES
¼" PLYWOOD BACK
35½"
31½"
¾"
5"
¾"
34½"
7¼"
¾"
⅜" X 1" DRAWER GUIDE
⅜"
⅝"
MOLDING
½"
8¾"
¾"
36"
6"
37½"
¾"
DRAWER GUIDES
18⅜"
CORNER BLOCK
⅜"
¼" PLYWOOD
⅜"
¾"
1"
¾"

BROADCAST SEEDER

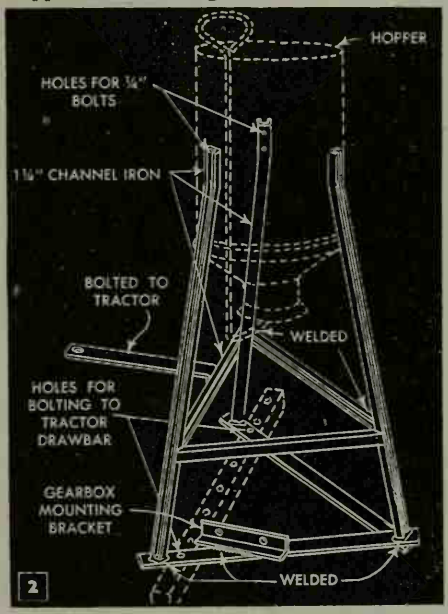




THIS EFFICIENT broadcast seeder was built by Frank Signs of Indiana for the special purpose of seeding a cover crop in growing corn at the time of the last cultivation. The seeder handles any of the common clover seed as well as rye, wheat and oats. When seeding in corn, a width of nine corn rows is covered on each trip across the field. The seeding rate is adjusted by means of a movable gate which slides across a seed port. An adjustable stop on the control rod permits the gate to be set to sow any amount of seed up to the full capacity of the seed-port opening. The stop also assures that the gate will be returned to the same position when the seed port is opened after the tractor is turned at the ends of the field.

A 10-gal. milk can, inverted and supported on a triangular frame, serves as a hopper, Fig. 1. Note that the frame is bolted to the tractor drawbar. The seed spreader, or slinger, consists of a disk-harrow blade fitted with angle-iron vanes and welded to one shaft of a right-angle gearbox such as that used on a combine. This drive unit is mounted inside the triangular frame in an inverted position and directly below the cover of the milk-can hopper. It is important when mounting the unit to place it off center with relation to the seed port so that the greater amount of seed will be thrown to the rear when the seeder is in operation. For example, if the

disk rotates counterclockwise, the seed port should be located to the left of the center of the disk so that the seed will be distributed uniformly by the vanes. The driving shaft of the gearbox is connected to the tractor power take-off through a universal joint and whatever length of shaft extension is necessary to assure a positive drive. Fig. 2 shows the frame which supports the hopper and the drive unit. Some changes may have to be made in order to accommodate other types of gearboxes and variations in tractor drawbars. For this reason, the frame is not fully dimensioned, and dimensions given are only average. For sowing under some conditions, it may be necessary to set the spreader disk at a greater height above the ground. To do this, it would only be necessary to build a higher mounting for the gearbox and lengthen the vertical hopper supports. All parts of the frame which support the hopper are welded together for extra strength and rigidity. In addition to being bolted to the tractor drawbar, the frame is also braced to the tractor transmission at some point where it is convenient to attach a brace. This will prevent the hopper from rocking forward or backward



when traveling over rough ground. In using a broadcast seeder of this type it is best to sow only on quiet days, especially when sowing clover or light, chaffy, grass seed. Sowing on windy days may result in an irregular distribution of the seed. If the spreader disk and vanes are discarded parts and are rough or rusty when installed, they are easily polished by feeding a quantity of sand through the mechanism.

SEED DUSTER

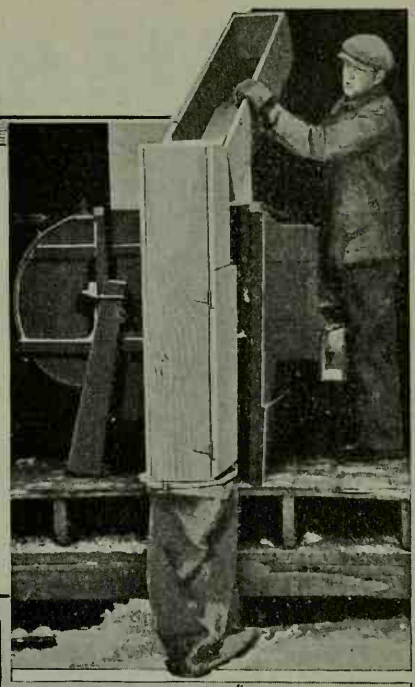
Seed Grain Treated for Disease In This Duster

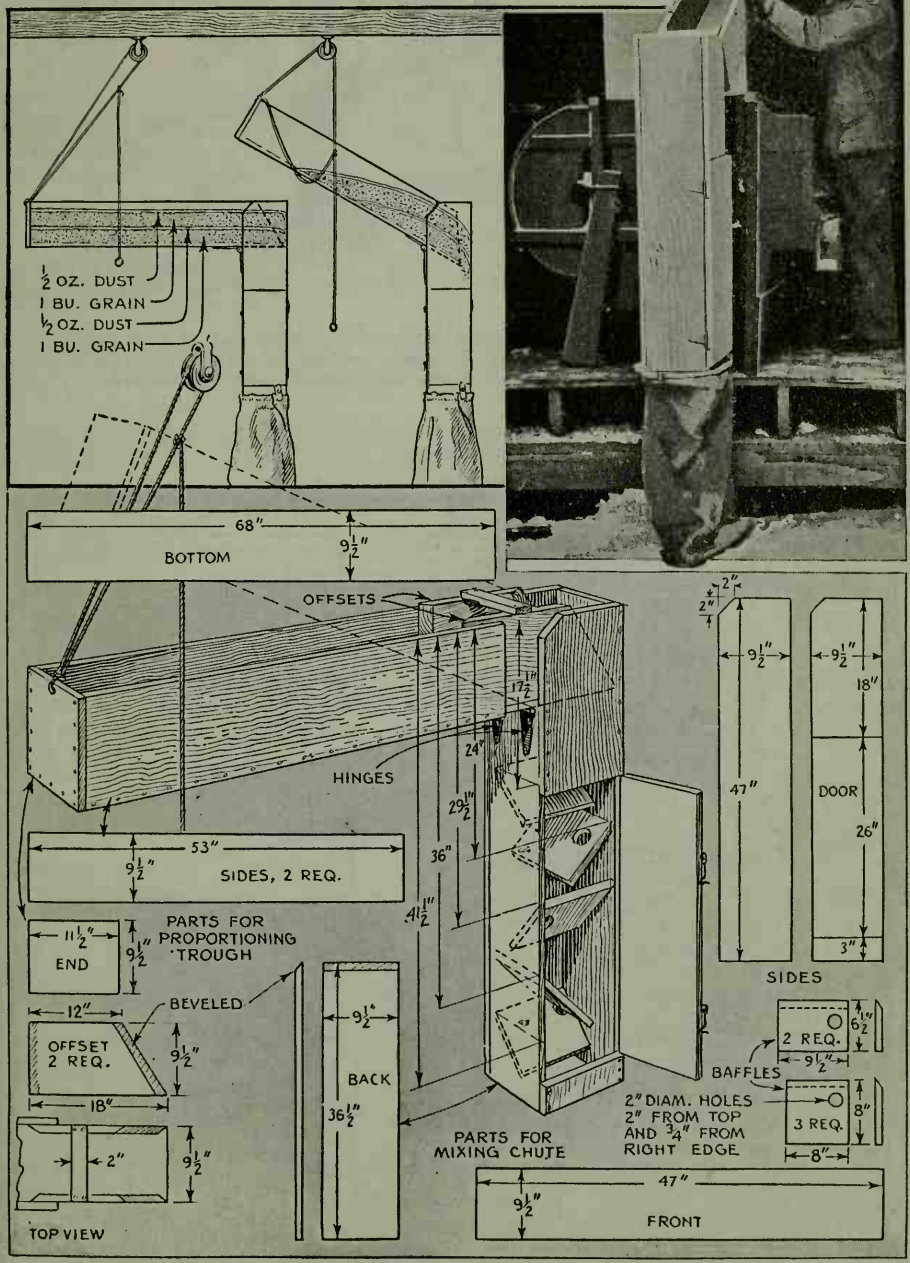
Designed by M. B. Moore of the Minnesota College of Agriculture, this duster enables two men to treat 40 to 60 bu. of seed grain an hour with chemical disinfectants. The seed is spread in layers in the proportioning trough which drops it over a series of baffle boards located in the mixing chute.

In building the duster, first nail up the mixing chute, placing the cleanout door on either side. Then comes cutting and placing of the baffles which is very important. The upper edges of these are beveled to 45° to fit snugly against the inside of the chute, and the grain of the wood should run from top to bottom. A 2-in. hole is bored in each baffle 2 in. from the top and ¾ in. from the right edge. Notice that there are three large baffles and two smaller ones which are placed alternately in the chute. first a large one and then a small one and so on. The top baffle is placed with its beveled edge running parallel to the proportioning trough and with the hole under the opening that will be made by raising the trough. The second baffle is turned ¼ turn to the right so that part of the grain sliding from the first baffle will fall through the hole in the second. Each following baffle is also turned ¼ turn to the right. When the mixing chute has been completed, assemble the proportioning trough and hinge it to the chute, pushing the trough clear into the front of the chute so that no opening is left unless the trough is raised. The free end of the trough is supported by a rope and pulley hung from the ceiling.

A bushel of seed is put into the trough and spread out evenly over the entire length. Over it is sprinkled the required amount of dust disinfectant, spread evenly in a line down the center of the trough from one end to the other. Next add the second bushel of grain and a second dose

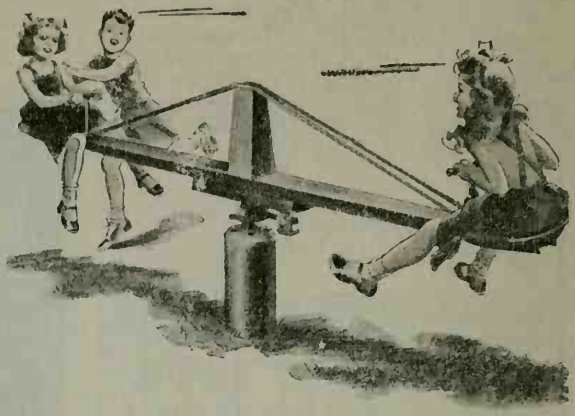
of disinfectant. Be sure that you have located the baffles correctly and fill the trough carefully as directed, as the effectiveness of the duster depends on these two points. Always clean the duster before treating a different variety of seed. Don't breathe the dust; all fungicides are more or less poisonous. It's best to wear a dust mask if treating much seed.



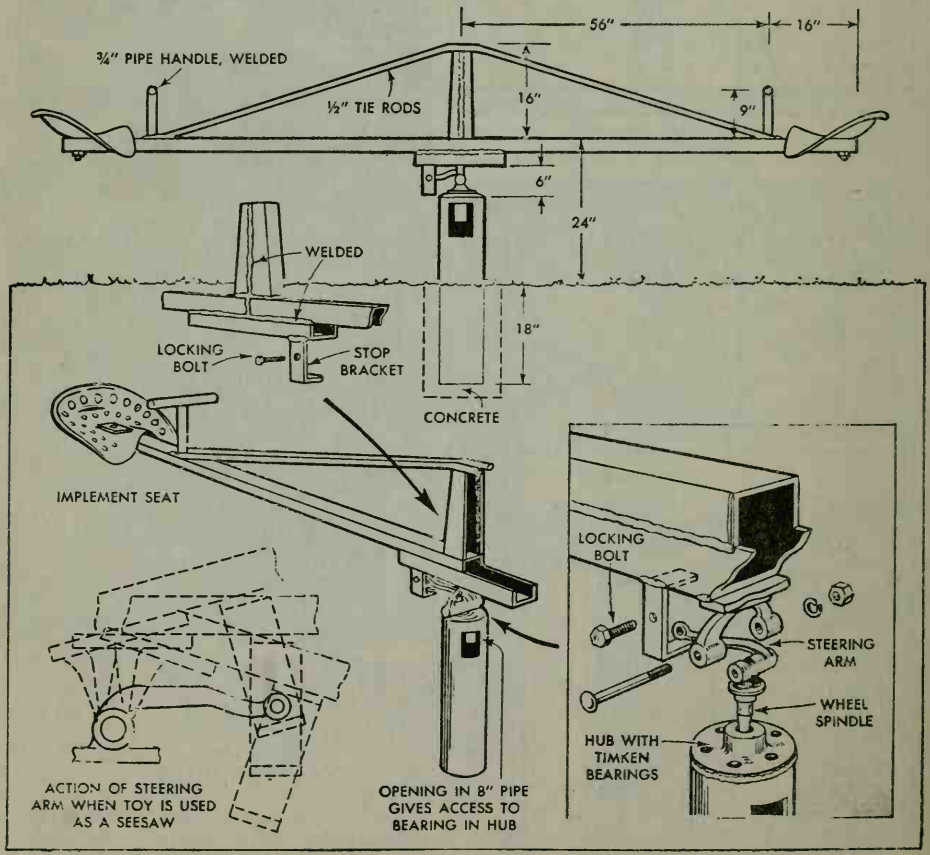


SEESAW DOUBLES AS MERRY-GO-ROUND

BUILT from scrap steel and auto parts, this novel back-yard toy combines the features of a seesaw with those of a merry-go-round. When used as a merry-go-round, the unit rotates on an old car-wheel spindle-and-hub assembly, plus a steering arm. The latter is used to lock the beam in a horizontal position when the toy is used as a seesaw. A U-shape bracket, through which a bolt is passed to engage the eye in the arm, limits the stroke and keeps the seats from striking the ground and jarring the riders. Note opening in side of pipe to permit access to bearing unit. To prevent its pulling out of the hub, a nut can be put on the wheel spindle. Lubricate before using.



Comfortable implement seats were used on the original toy but suitable seats can be cut from wood. The supporting pipe column, which houses the hub-and-spindle assembly, is embedded in concrete

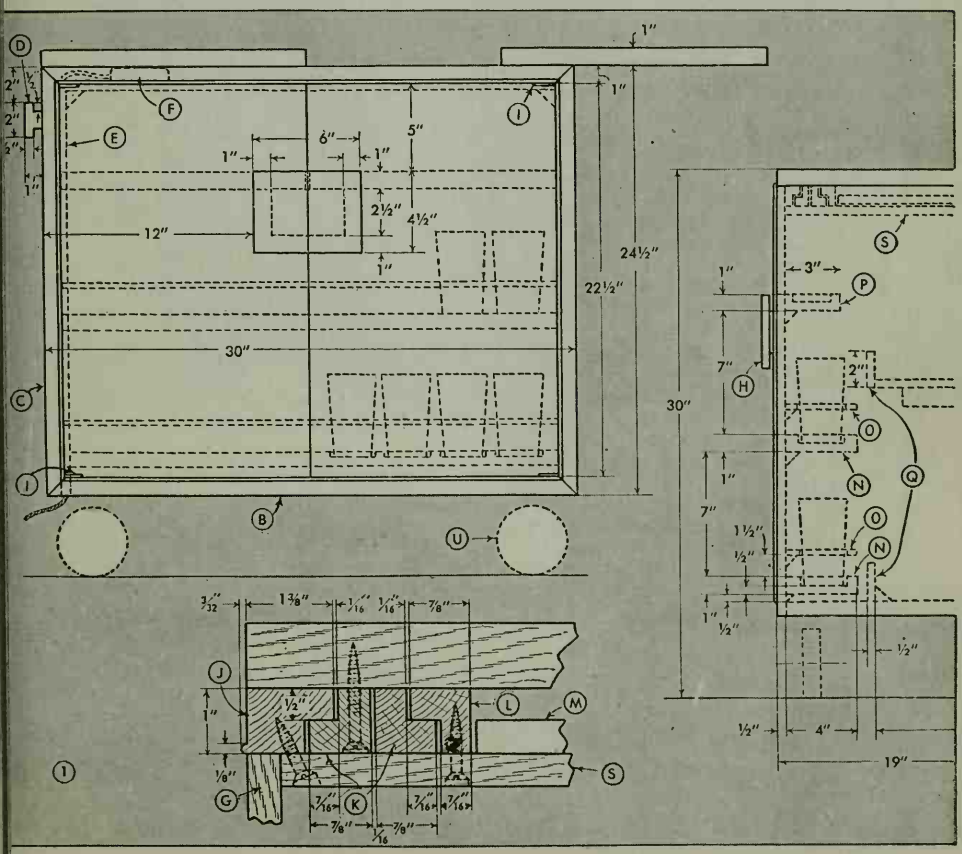


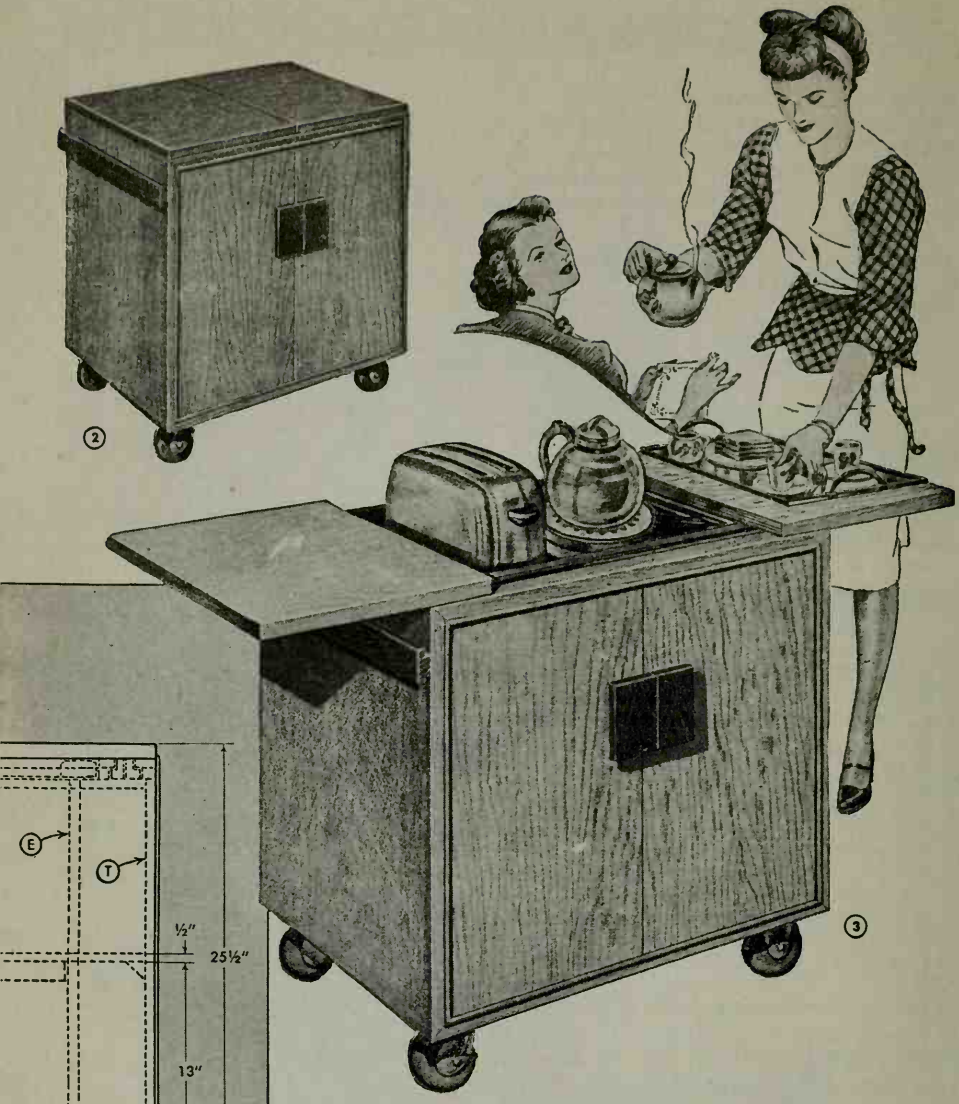
SERVING CART

Streamlined version of the tea wagon is wired for toaster and electric plate. Has plenty of room for dishes and glassware

WHETHER it's your turn to entertain at bridge or you're just having the neighbors in—that's when you'll want to wheel out this smart looking serving cart. It's just the thing beside the bridge table for coffee and light snacks, or to assist in serving at a small dinette table. There's plenty of space for dishes and glassware as indicated in Fig. 4, and the divided top slides back to reveal a metal tray and an outlet to plug in a toaster and electric plate as shown in Fig. 3. The whole thing closes up into the neat little cabinet in Fig. 2 which can be pushed into a corner out of the way when not in use.

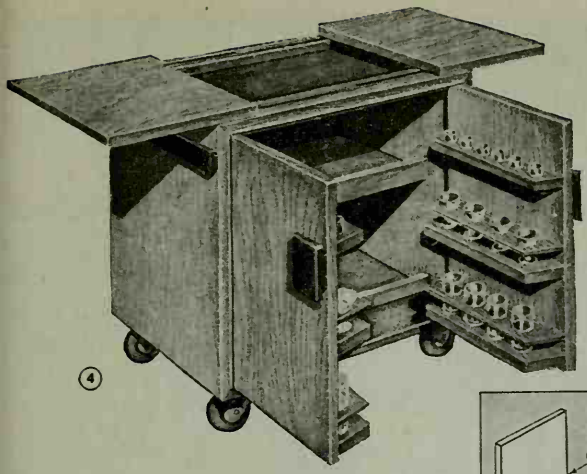
Construction is a fairly simple joining job as detailed in Fig. 1. Although standard 1 1/16-in. solid stock is called for, which allows 1/16 in. for dressing, construction can be of 3/4-in. plywood if the dimensions are changed and minor alterations are made in the assembly. Panels for the sides and bottom of the cabinet are built up in width from several pieces doweled and glued edgewise. From the pull-apart view in Fig. 5 you can see how the pieces go together. Note that a small beading is run on the inner edges of the panels. If the mitered corners specified are difficult for you to cut, the pieces can be butted and fastened with screws driven at an angle through the bottom and into the side. If mitered, nails can be driven up from the bottom without showing. Four rabbeted rails join the end members at the top, two at the front and two at the back. Note in Fig. 5 that rails J are mitered and rails L are set flush in mortises located ac-





MATERIAL LIST

Part	Required	Size (Finished dimensions)	Name
A	2 pcs.	1 x 15 x 19 in.	Top
B	1 pc.	1 x 19¼ x 30 in.	Base
C	2 pcs.	1 x 19¼ x 24½ in.	Sides
D	1 pc.	1 x 2 x 19 in.	Push handle
E	1 pc.	½ x 23½ in.	Thin-wall conduit
F	1	Extension cord and double receptacle	
G	2 pcs.	½ x 14 x 22½ in.	Doors
H	2 pcs.	¾ x 3 x 4½ in.	Door handles
I	4 prs.	Concealed hinges (type shown)	
J	2 pcs.	1 x 1½ x 30 in.	Outer guide
K	4 pcs.	1 x ⅞ x 16¾ in.	Slides
L	2 pcs.	1 x ⅞ x 29 in.	Inner guide
M	1	20-ga. sheet-metal tray (removable)	
N	4 pcs.	1 x 4 x 14 in.	Shelves (glasses)
O	4 pcs.	¼ x 4 x 14 in.	Retainer strips
P	2 pcs.	1 x 3 x 14 in.	Upper shelf (door)
Q	2 pcs.	½ x 2 x 28 in.	Bottle shelf (front)
R	1 pc.	½ x 13 x 28 in.	Bottle shelf
S	1 pc.	½ x 18 x 28 in.	Tray baseboard
T	1 pc.	½ x 22½ x 28 in.	Back
U	4	4-in.-dia. rubber wheels (2 swivel type)	

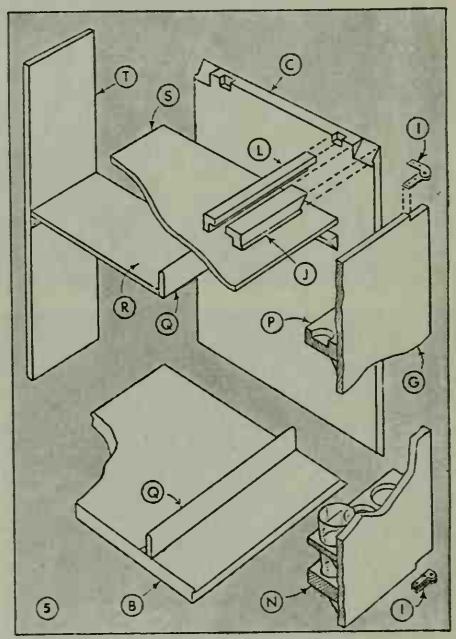


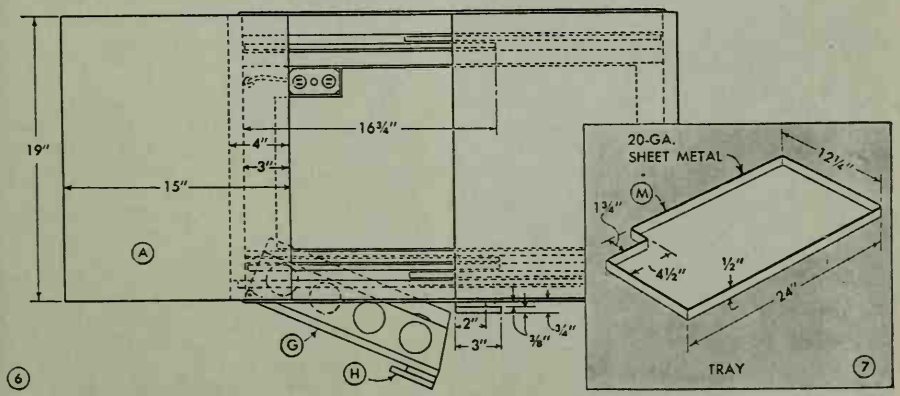
the type of concealed hinge to use. Finally, counterbored racks are attached to the inside of the doors for small glasses, and a two-part knob, built up of two blocks, is attached with screws from the back, one half to each door. A handle for guiding the cart is attached to the left-hand end near the top. Any suitable rubber-tired truck casters, about 4 in. in diameter, will do, although two of them should be of the swivel type to make the cart easy to steer.

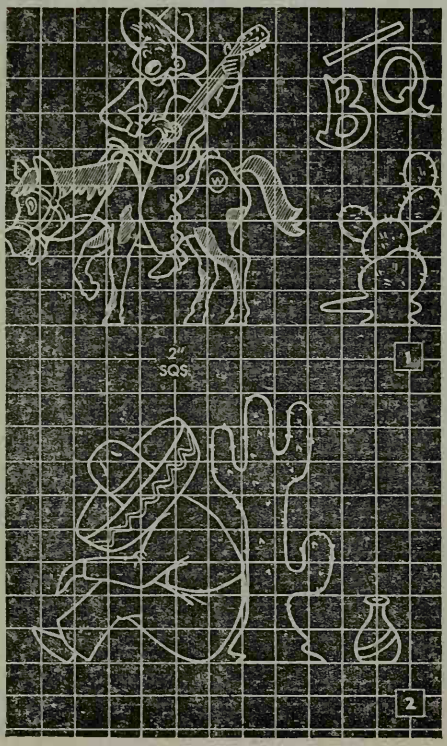
cording to the sectional detail in Fig. 1. When these are in place, the back is fitted to set-in the thickness of the beading.

At this point the sliding top must be attached to slides K, each half of the top being fastened to one set of slides. Notice in Fig. 5 that one set extends past the other to provide a stop so that they cannot be pulled all the way out. Pieces of thin cardboard inserted between the slides and guides before the former are screwed to the top will prevent binding. Next, panel S, which forms a recess for the tray detailed in Fig. 7, is installed. This is screwed to rails J and L as in Fig. 1 and is cut to allow the doors to fit flush when they are hinged. A two-plug receptacle is located as in Fig. 6 and is wired with an extension cord that runs down through a length of conduit and out the bottom of the cabinet.

This leaves the doors to be fitted and hinged. Like the back, the doors are set-in the thickness of the beading. Fig. 5 shows

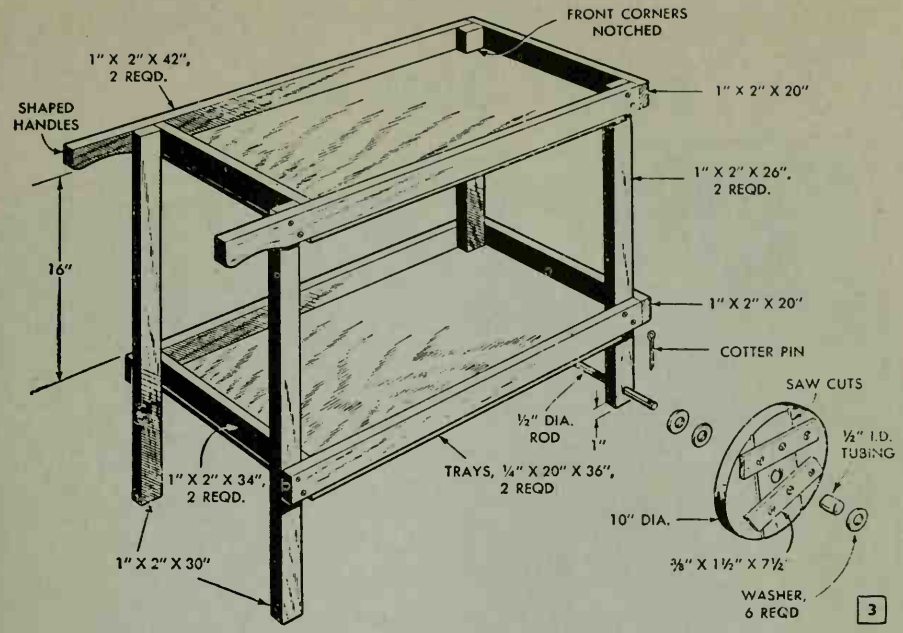






SERVING CART

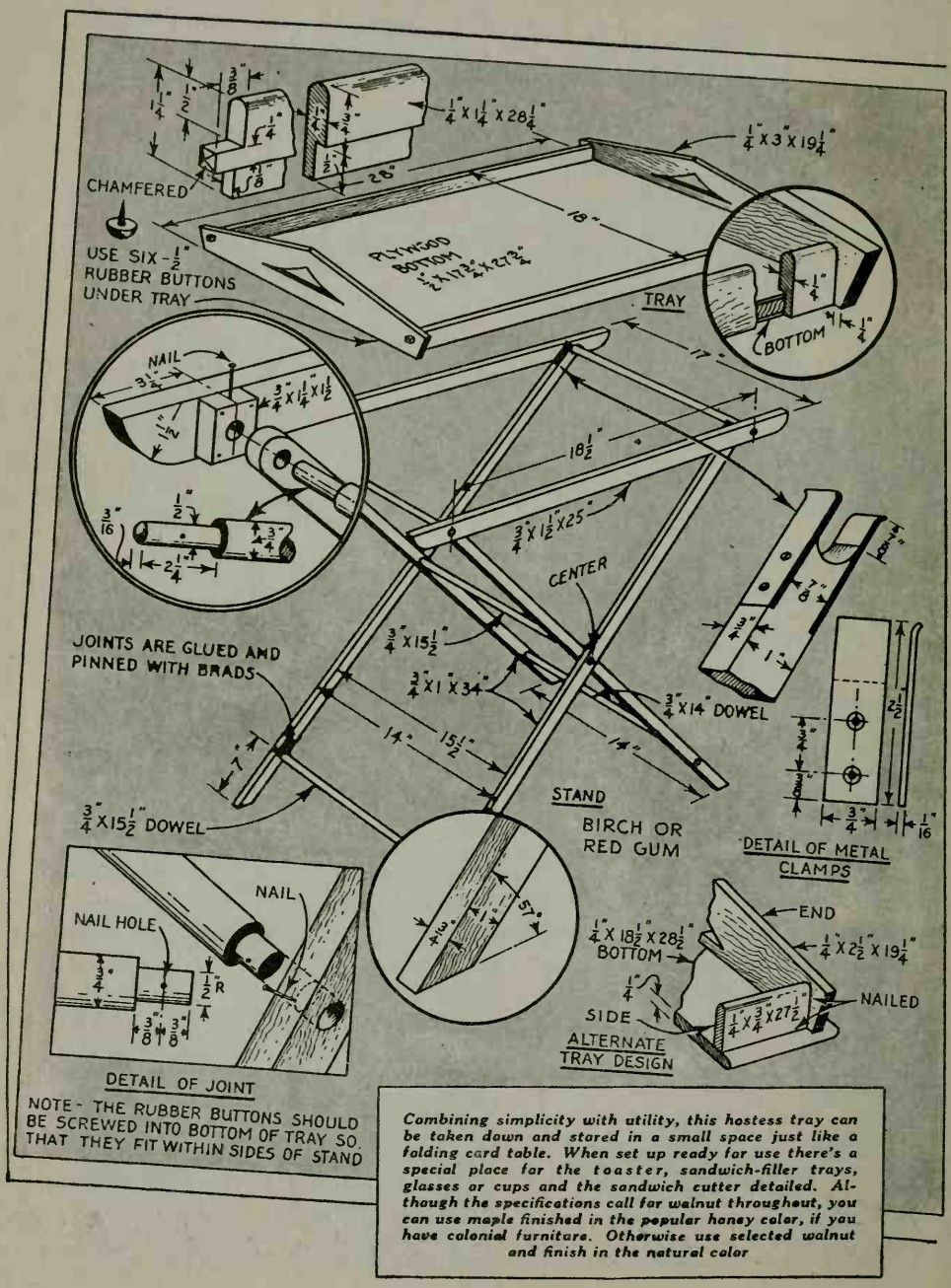
THIS CHUCK WAGON with its large trays takes care of the transportation problem for both the host and hostess at a garden barbecue. Usually one trip with the wagon from kitchen to outdoor fireplace does the whole job of delivering the necessary dishes, utensils and food. This one is pushed wheelbarrow-fashion and has been specially designed for easy construction. The plywood sheets can be reinforced and installed loosely if you desire removable trays for serving purposes and easy cleaning. Note in Fig. 3, for example, that at the front end of the framework the two horizontal members of the frame, which also form the ends of the trays, overlap the lengthwise members and enclose the uprights. At the rear of the frame, the two corresponding pieces are placed ahead of the uprights and are butted against the sides of the lengthwise members. This arrangement of parts makes it easy to join the frame with screws and glue without the necessity of cutting mortises or half laps. Assembly of the parts is clearly shown in Fig. 3. Shape handles by rasping away the wood and finishing with sandpaper. The



bottoms of the trays are of plywood or hardboard and the corners must be carefully notched to fit around the uprights. Before installing the tray bottoms permanently, they are decorated with the character decorations suggested in Figs. 1 and 2. This can be done by transferring the full-size outlines to the wood with carbon paper and then burning in the outlines or by painting with suitable enamel colors. After completing the trays and framework. All parts are finished with a coat of orange shellac and one of spar varnish. To carry out the chuck-wagon motif a step further, make the wheels as in Fig. 3. Saw two ¾ x 10-in. disks and center-drill them for ½-in. brass or bronze bushings as indicated. After driving the bushings in place, make shallow saw cuts on the outside face of each disk as shown. Then fit two cleats at the angle shown and fasten in place with screws. Drill the front frame uprights for a ½-in. shaft, and then assemble the wheels on the shaft with washers and cotter pins. Finish the wheels to match the frame. Although pine is a satisfactory wood to use, oak is best for both the frame and wheels, as it is much more durable. If used outdoors, the parts of the chuck wagon that are in constant contact with the ground should be repainted or varnished occasionally in order to minimize the effects of moisture absorption that would cause the wood to rot.

Attractive Serving Boards Are Fashioned From Hardwood Scraps

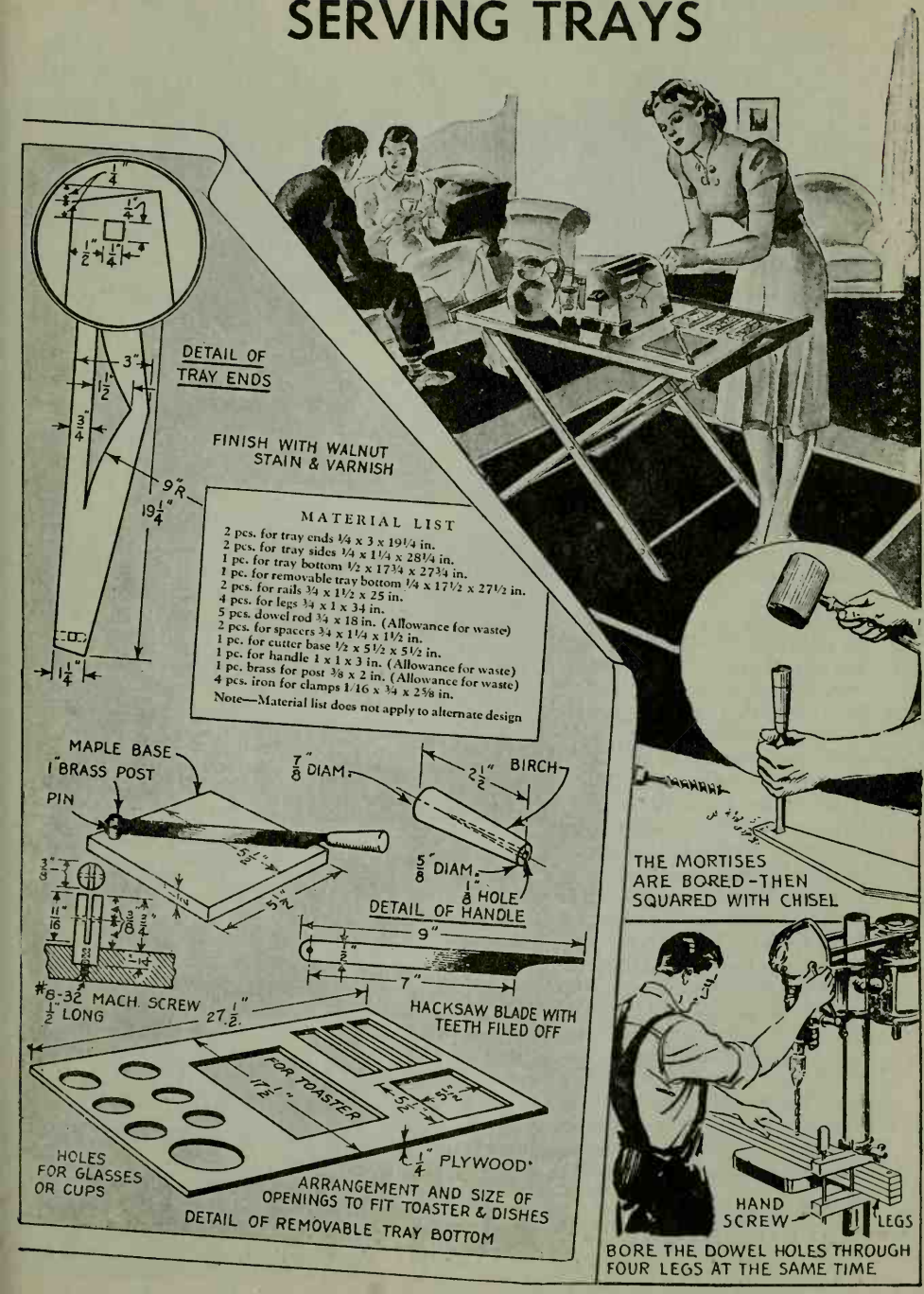
Scraps of hardwood that you may have in your basement will provide all the raw material necessary for several cutting boards of attractive design. They can be turned on the lathe or cut into any of various patterns, such as pear and kidney shapes, or in rectangles, triangles and squares. Sand the board smooth and finish in a natural color, applying two or three coats of clear shellac. Use the underside of the board for slicing, mincing and chopping, and the finished top for serving.



NOTE - THE RUBBER BUTTONS SHOULD BE SCREWED INTO BOTTOM OF TRAY SO THAT THEY FIT WITHIN SIDES OF STAND

Combining simplicity with utility, this hostess tray can be taken down and stored in a small space just like a folding card table. When set up ready for use there's a special place for the toaster, sandwich-filler trays, glasses or cups and the sandwich cutter detailed. Although the specifications call for walnut throughout, you can use maple finished in the popular honey color, if you have colonial furniture. Otherwise use selected walnut and finish in the natural color

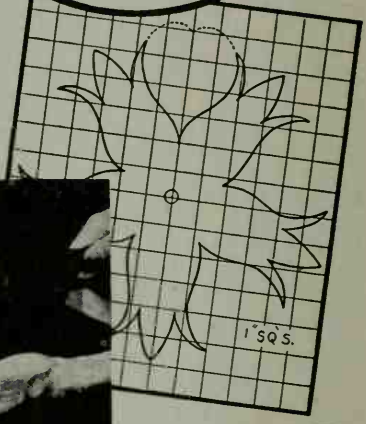
SERVING TRAYS

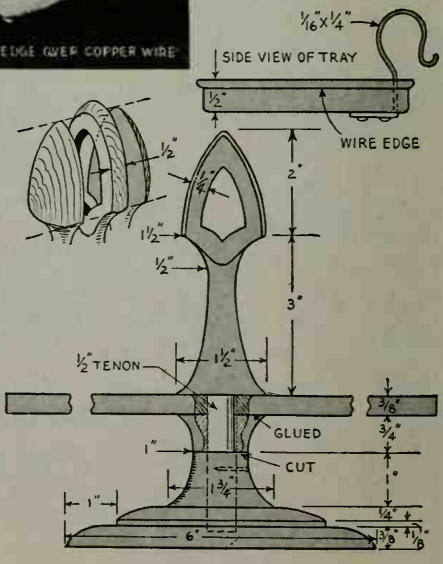


SERVING TRAYS

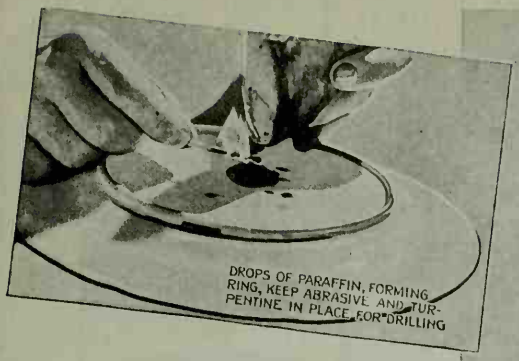
Gleaming metal trays in sharp contrast to a walnut stand go to make this attractive tray a smart accessory at bridge

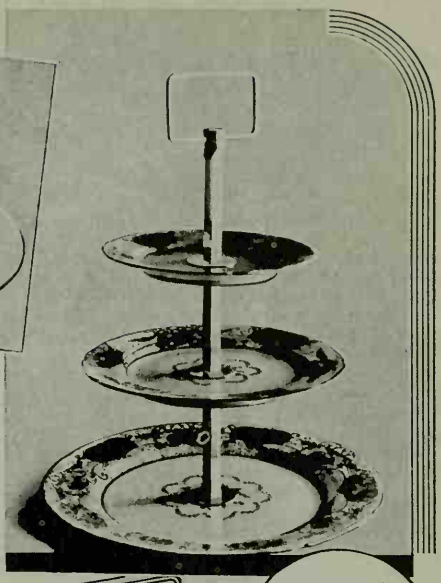
THIS revolving stand with five individual trays formed of sheet copper in the popular leaf design provides a stunning piece for serving candy, relishes or canapes. To make it, first draw an enlarged paper pattern of the tray platform, and jig saw it from ⅜-in. plywood. The turned parts between which the platform revolves consists of a two-part base into which a tenoned handle is pinned to the lower half, the upper half being glued to the bottom of the platform, but not to the tenon. The center of the handle is cut out after two sides have been flattened as shown. Ample clearance is left between the handle and the platform to allow the latter to rotate easily after the finish has been applied. Either sheet copper or brass of about a No. 16 ga. is best from which to form the leaf-shape trays. These are hammered to fit the platform openings, the edges are turned over soft wire, and completed by riveting small bent handles to the bottom and edge. A block of hardwood, over which the trays are formed, is cut slightly smaller than the opening in the platform. Buff the trays and apply a thin coat of clear lacquer to keep them bright.



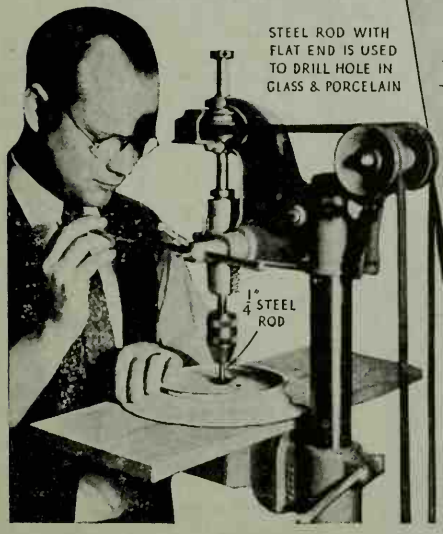


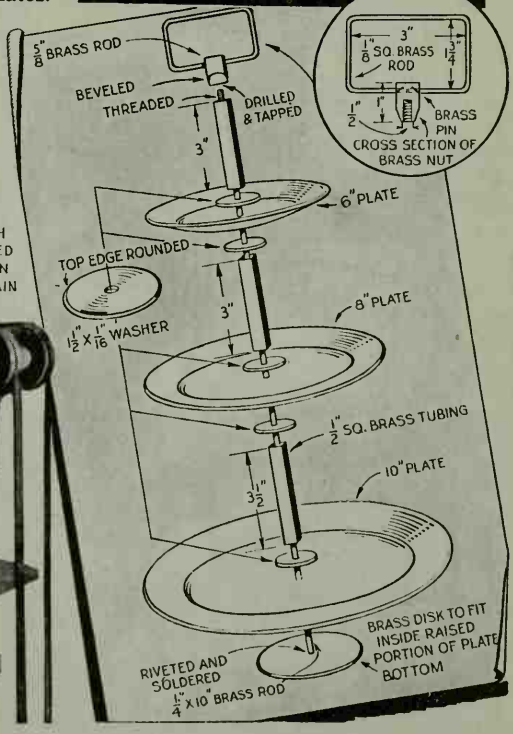
SERVING TRAYS





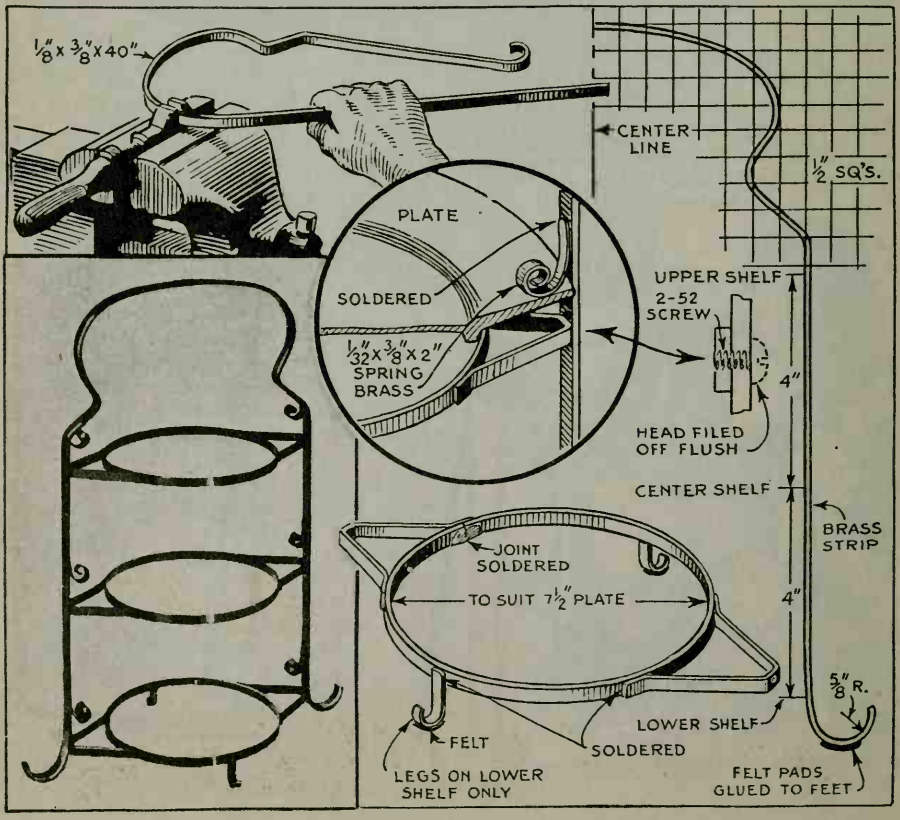
RIGID three-deck sandwich trays cost comparatively little when made from brass stock and china plates. Holes are drilled through the plates so they can be slipped over a brass rod, turpentine and emery powder being used as a cutting fluid. Pieces of square brass tubing and brass washers are used to space the plates. The rod is threaded at the upper end, while the other end is riveted and soldered to a brass disk, on which the bottom plate rests. A handle is pinned to a round brass nut, which fits the threaded end of the rod. The brass should be polished and lacquered.

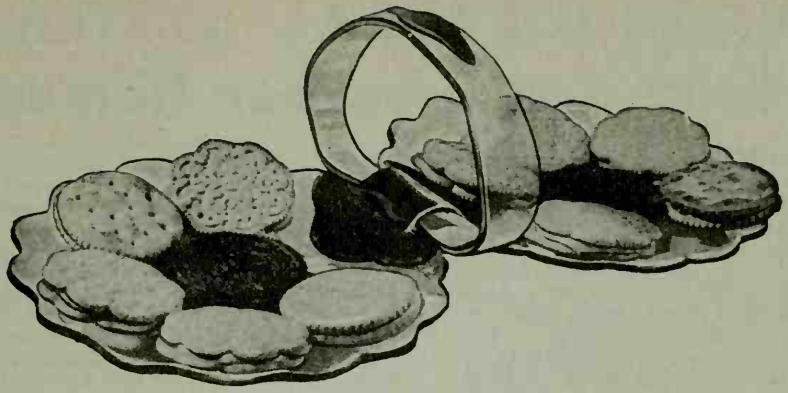




SERVING TRAYS

Three smart dessert plates and several lengths of flat brass stock are all you need to make this novel serving tray which is especially convenient for evening snacks. The framework consists of two legs formed from a single length of flat brass, bent at the center to form a handle and rounded at the ends to form feet. Bending is done between the padded jaws of a monkey wrench held in a vise. Note the use of small machine screws in addition to solder to assure sufficient strength where the plate holders are joined to the vertical pieces. The rings should fit around the bottom of the plates, and small spring clips soldered to the vertical pieces hold the plates in place, yet permit their removal for washing. Two short feet are provided on the lowest ring so that the stand has a four-point support. Felt pads attached to the feet prevent marring furniture finish

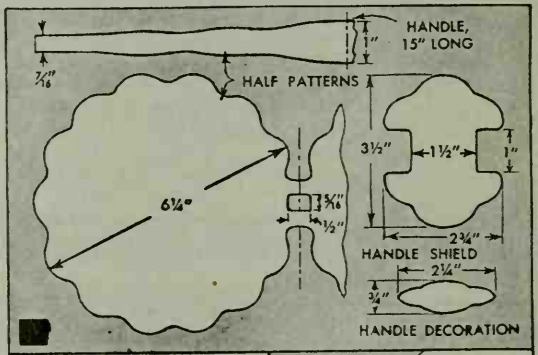


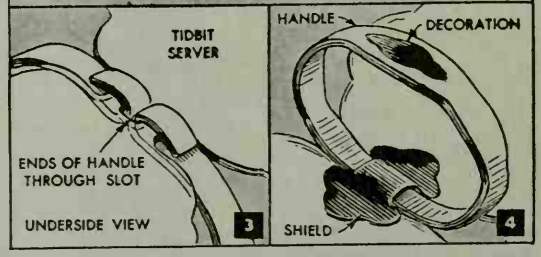


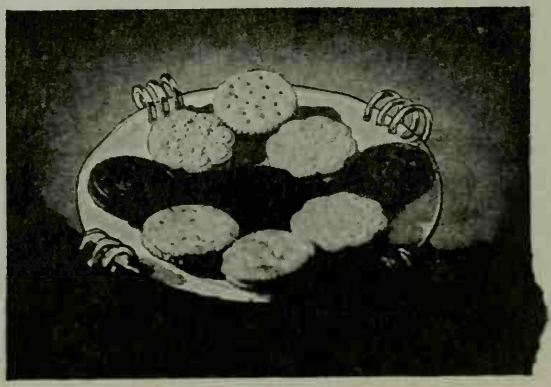
1

POSSESSING the novelty and simplicity of items found in expensive gift shops, these two plastic tidbit servers provide excellent projects for the beginner. Both trays of the server shown in Fig. 1 are formed from a single sheet of clear ⅛-in. heat-forming plastic. The pattern for the tray, Fig. 2, is traced directly onto the protective paper which covers the plastic, making it easy to follow the line in sawing the parts to shape. The paper covering is removed after sawing and the edges of the plastic are smoothed with a fine file and polished on a cloth buffer charged with rouge. To dish the trays, the plastic is first heated in the kitchen oven at 250 deg. F., which makes it very pliable. Then, handling it with gloves, lay the plastic over two saucers placed side by side. Only light pressure is required to make it conform to the shape of the saucers. Work rapidly as the plastic cools quickly. The handle is heated and attached to the server as in Fig. 3, the ends being bent upward against the underside of the trays. Finally, the hole through which the handle passes is covered with a shield of colored plastic, Fig. 4, and a colored decoration is cemented to the top of the handle.

The server in Fig. 5 is dished in the manner described above and four feet are added by heating and coiling ⅛-in. plastic rod around a broomstick and threading it through holes drilled in the edge of the server as indicated.

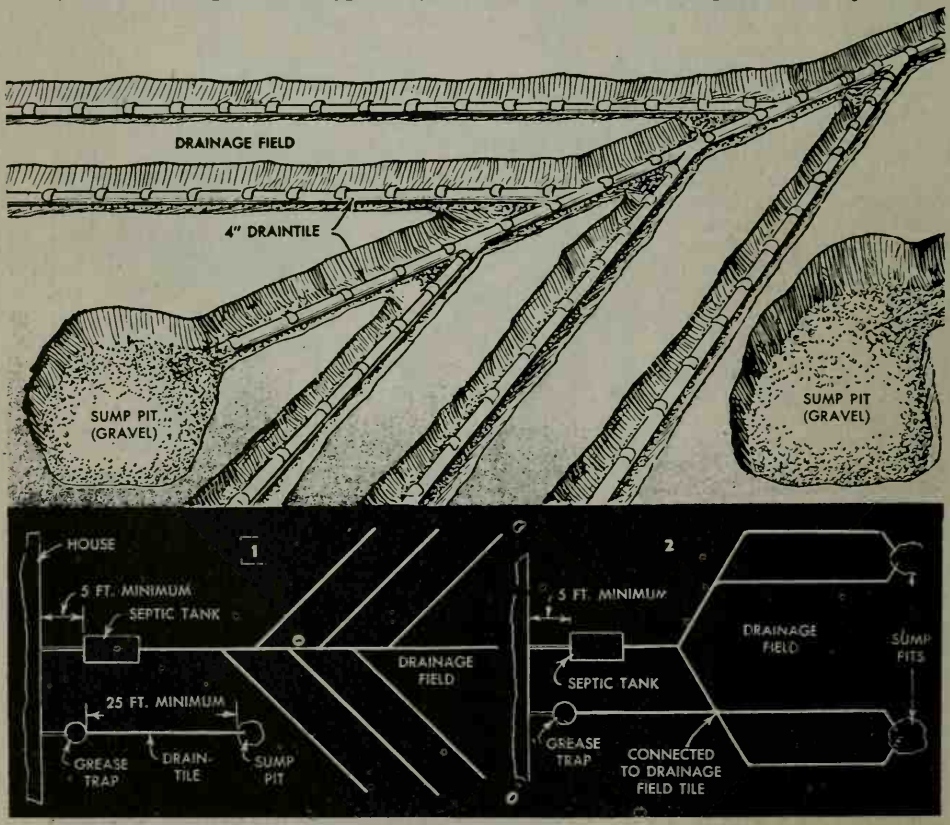




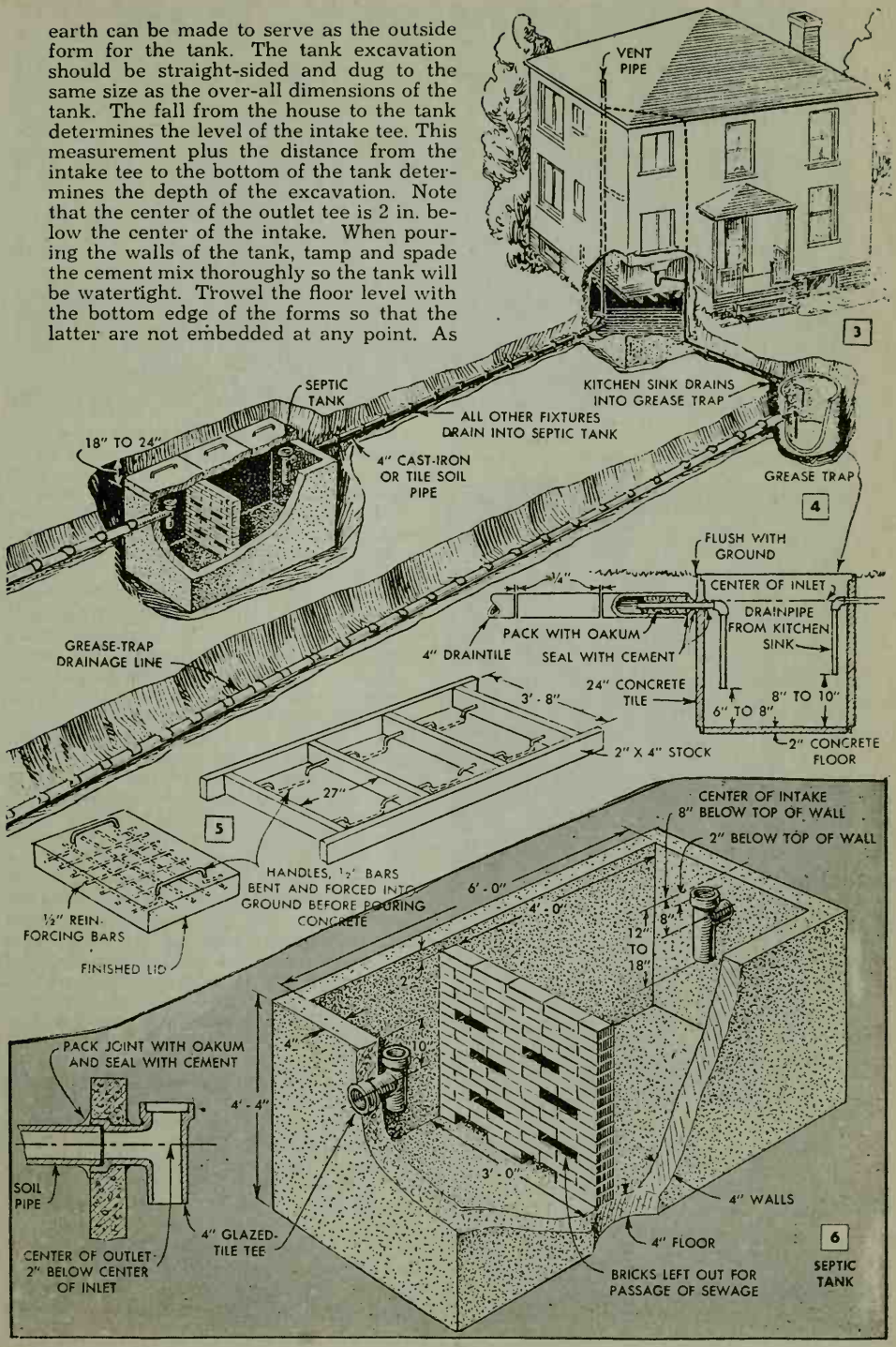


SEWAGE-DISPOSAL SYSTEM for farm and suburban homes

IN BUILDING or modernizing farm homes, lake cottages and suburban homes in areas where public sewers are not available, the septic-tank system provides a safe, reliable and inexpensive installation for the disposal of household wastes. The operation of the tank is almost wholly automatic, as it disposes of bathroom and kitchen wastes by a process of bacterial disintegration and releases only liquid residues, or effluent, to the drainage field. Here, the effluent is dispersed through a system of drainage tile where it is absorbed by the soil and is eventually made harmless by the action of soil bacteria. A two-compartment tank of average size is detailed in Fig. 6. It is of monolithic concrete construction and has a capacity of over 600 gallons, which is sufficient for a family of four to six persons. A typical layout of separate disposal systems for the kitchen and bathroom of a rural home is shown in Fig. 3. Tile in the drainage field can be arranged as a series of branches in alternate directions from a main tile line, as in Figs. 1 and 3, or as a Y-branch connected into parallel lines of dispersal tile, as in Fig. 2. Where it is necessary to install the disposal field on rolling ground or a fairly steep slope, the main outlet tile from the septic tank often is led into a concrete distribution box from which dispersal tile lines are taken off at approximately right angles with the slope. In locating the tank, the minimum distance from the house foundation to the tank is 5 ft., Fig. 1. In most cases, it is better to locate the tank 10 ft. from the foundation and at least 50 ft. from any source of water supply. Once the tank is set, it can then be forgotten. Usually the

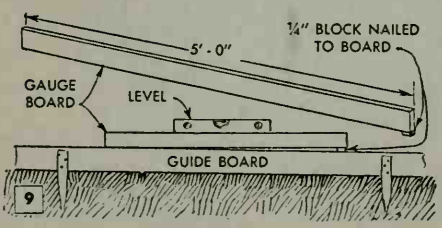


earth can be made to serve as the outside form for the tank. The tank excavation should be straight-sided and dug to the same size as the over-all dimensions of the tank. The fall from the house to the tank determines the level of the intake tee. This measurement plus the distance from the intake tee to the bottom of the tank determines the depth of the excavation. Note that the center of the outlet tee is 2 in. below the center of the intake. When pouring the walls of the tank, tamp and spade the cement mix thoroughly so the tank will be watertight. Trowel the floor level with the bottom edge of the forms so that the latter are not embedded at any point. As



A long guide board fitted with sharpened stakes is an aid in digging a straight trench to correct grade

In heavy soils where the natural drainage is slow, disposal tile should be embedded in washed gravel



soon as the concrete has set (allow 36 to 48 hrs.) remove the forms and cover the excavation and the tank with boards and a light covering of earth. Allow the concrete to cure for at least a week. Then lay up a brick wall inside the tank 4 ft. from the intake end, leaving openings in the wall as indicated in Fig. 6 to allow passage of the liquids from one compartment to the other.

Before beginning construction of the sewer line from the house to the tank, be sure that the trench is dug with the correct slope. Fall for the 5 or 10-ft. run from the house to the tank should not exceed ¼ in. per ft. If the sewer line passes under a driveway or if it is likely at any time to be subjected to a heavy weight, use cast-iron soil pipe for the full run. Otherwise use ordinary bell tile. Make the first joint to the tile tee as in the left-hand detail in Fig. 6. Force a tight-fitting swab, such as a burlap bag, into the bell end of the tile, or pipe. Trowel cement mortar (equal parts cement and sharp sand) into the lower part of the bell end. Then place the second section and force additional mortar around the inserted end of the tile until the space is completely filled. Check to make sure the tile section is on the proper grade and then pull the swab past the joint and up to the open bell end of the second section. Install the remaining lengths of tile, or pipe, in the same manner, pulling the swab through to smooth the inside surface of each joint as it is completed. Cut the last section, which should be cast-iron soil pipe, to the proper length so that, when installed, the bell end will project through the basement wall. Force cement mortar into the wall opening to seal it watertight. Fill the ditch to the top of the tile and allow the cement

As the open-end tile are laid, each joint is covered with a rectangular piece of extra-heavy tarred paper

After laying and leveling to grade, tile line is covered with a layer of gravel as shown above and below

mortar to cure. Then use a small tamping stick to tamp the layer of soil firmly, forcing it under the tile. Add another layer and tamp, and repeat until the trench has been filled. This procedure assures that the soil will not settle unduly in the trench and eliminates the danger of the settling breaking the tile joints.

The outlet sewer line and the disposal lines are laid with open-end tile. The fall of the lines should not exceed ¼ in. in 5 ft., Fig. 9. Make a guide board and a gauge board, as shown, for laying out and leveling the trenches, Figs. 7, 8 and 9. Dig the trenches body width so you can work easily at the bottom. Lay the tile with joints spaced about ⅛ in. and check every 5 ft. to make certain that the grade is uniform. Cover each joint with a rectangular section cut from heavy roofing or asphalt-coated paper, Fig. 11. In heavy soils where drainage is slow, tile should be embedded in washed gravel as in Figs. 10, 12 and 13. In addition, many rural builders install a gravel sump pit at the end of the main disposal line as in Figs. 3 and 4. Where natural drainage is good, the sump pit is neither necessary nor advisable as it may accelerate drainage to lower levels and leave the disposal line "dry." Aggregate length of the disposal lines will vary with the general lay of the land, soil permeability and size of the tank, but in no case should the tile line be less than 100 ft. long, with 40 to 60 ft. of disposal tile per person being the safest average. Never discharge disposal lines into a stream, pond or lake, into old wells or onto the surface of the ground. The kitchen disposal line is installed in the same way as the septic-tank system, using a length of concrete tile for the grease trap,

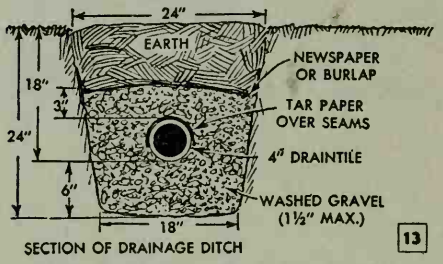


Fig. 4. This is embedded at grade level or a little below, and intake and outlet pipes installed as shown. The disposal line should be straight and at least 60 ft. long, Fig. 3. The trap is covered with a cast-iron or cast-concrete lid.

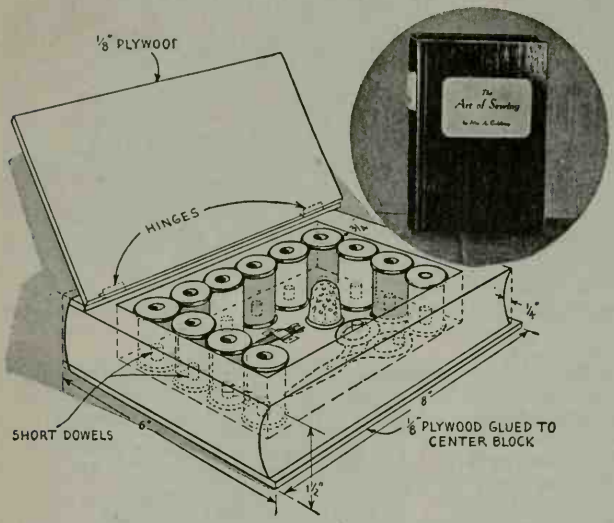
Complete the installation of the system by making the 3-piece cover for the septic tank. This is cast from concrete in a form made as in Fig. 5. Cast two metal handles and reinforcing rods into each unit as indicated. After the castings have cured, place them over the tank and cover with earth to the grade level. Both the grease trap and the septic tank should be vented. If the kitchen sink is some distance from the bathroom, then the grease trap must be vented separately, as long horizontal runs in a vent are not approved. Otherwise both can be vented to a single stack as indicated by the dotted lines in Fig. 3. Inside plumbing must be installed by approved methods and all fixtures should be properly trapped.

¶ Holes in concrete are ordinarily caused by air bubbles. These may be eliminated by stirring, after the concrete has been placed in the forms, with long iron rods.

SEWING KIT

This Sewing Kit Can Be Kept Handy Between Book Ends

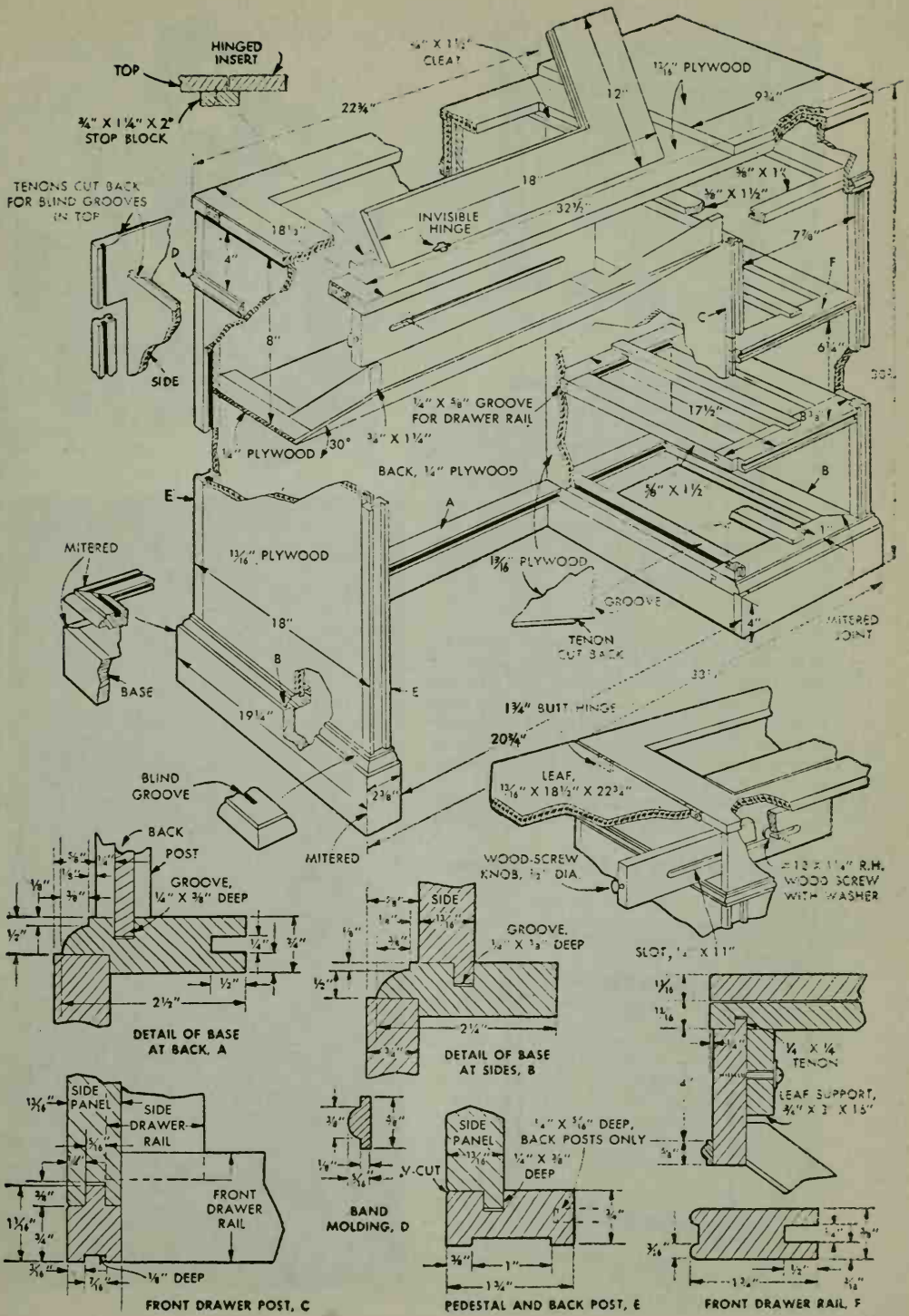
This kit can be kept in a bookcase, between book ends or any other place where it will keep your sewing accessories handy at all times. It is made from a block of wood which is cut out in the center and fitted with a front and back of plywood or other suitable material, the front being hinged to form a lid. The edges of the block are shaped to resemble the pages of a book. If desired, the front and back can be covered with cloth, imitation leather or other suitable material to make the appearance more authentic. Short dowels hold spools of thread, and thimbles, scissors, etc., are slipped over corks, which are screwed to the bottom of the kit inside the recessed block.

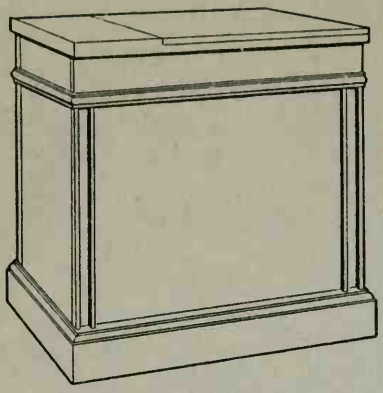


SEWING MACHINE CONSOLE

WHY PUT UP with the inconveniences of an unsightly electrified treadle or portable sewing machine, or an outmoded console type, when you can so easily modernize any one of them by fitting the sewing head into this fine console? Characteristic design features are carried out in detail both on the front and back of the cabinet. As you will see from the lower left-hand drawing on page 71, the cabinet can be made smaller where space is limited or if the tier of drawers is not desired.

Structurally, the cabinet is designed to make a neat, drumtight job with a minimum of individual joints. Note that the plywood side panels are rabbeted and grooved to take facing strips, or posts, of solid stock. The inner faces of the pedestal and back posts are grooved to fit over long tenons formed by the rabbets in the side panels. These decorative facings extend from the base frame to the lower edges of the front and back aprons which support the span of the top. The bottom edge of the back apron and the inner edges of the back posts are grooved to house the ¼-in.-plywood back panel. The top edges of the front and back aprons are rabbeted to form long tenons which fit into blind, or stopped, grooves cut in the subframe of the top assembly. Now, before you cut stock for the front and back posts, note that the front drawer posts are only $1\frac{3}{16}$ in. wide, section C, and that a tongue is cut on the back edge of each to form a long tenon fitting into grooves cut in the front edges of the plywood panels. All posts have a shallow groove centered on the front face as a decorative feature. The

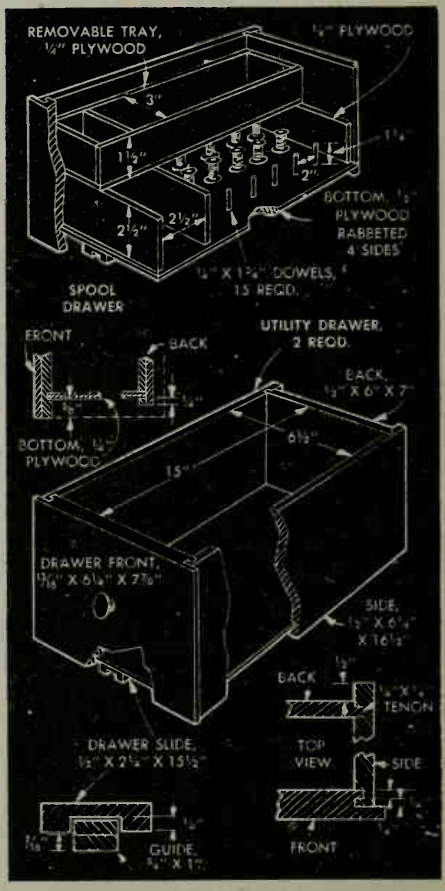

HINGED INSERT
TOP
¾" X 1¼" X 2" STOP BLOCK
TENONS CUT BACK FOR BLIND GROOVES IN TOP
SIDE
INVISIBLE HINGE
¼" X ⅝" GROOVE FOR DRAWER RAIL
¼" PLYWOOD
30°
¾" X 1¼"
BACK, ¼" PLYWOOD
13/16" PLYWOOD
MITERED
BASE
MITERED JOINT
GROOVE
TENON CUT BACK
1¾" BUTT HINGE
LEAF, 13/16" X 18½" X 22¾"
BLIND GROOVE
MITERED
WOOD-SCREW KNOB, 1½" DIA.
SLOT, ¼" X 1"
BACK POST
GROOVE, ¼" X ⅜" DEEP
DETAIL OF BASE AT BACK, A
SIDE
GROOVE, ¼" X ⅜" DEEP
DETAIL OF BASE AT SIDES, B
¼ X ¼ TENON
LEAF SUPPORT, ¾" X 2" X 15"
SIDE PANEL
SIDE DRAWER RAIL
FRONT DRAWER RAIL
⅛" DEEP
FRONT DRAWER POST, C
V-CUT
BAND MOLDING, D
¼" X ⅝" DEEP, BACK POSTS ONLY
¼" X ⅜" DEEP
PEDESTAL AND BACK POST, E
FRONT DRAWER RAIL, F



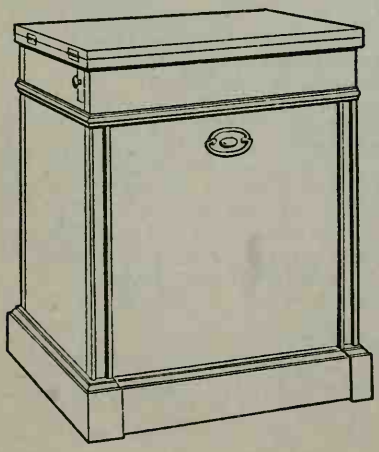
Rear view of console

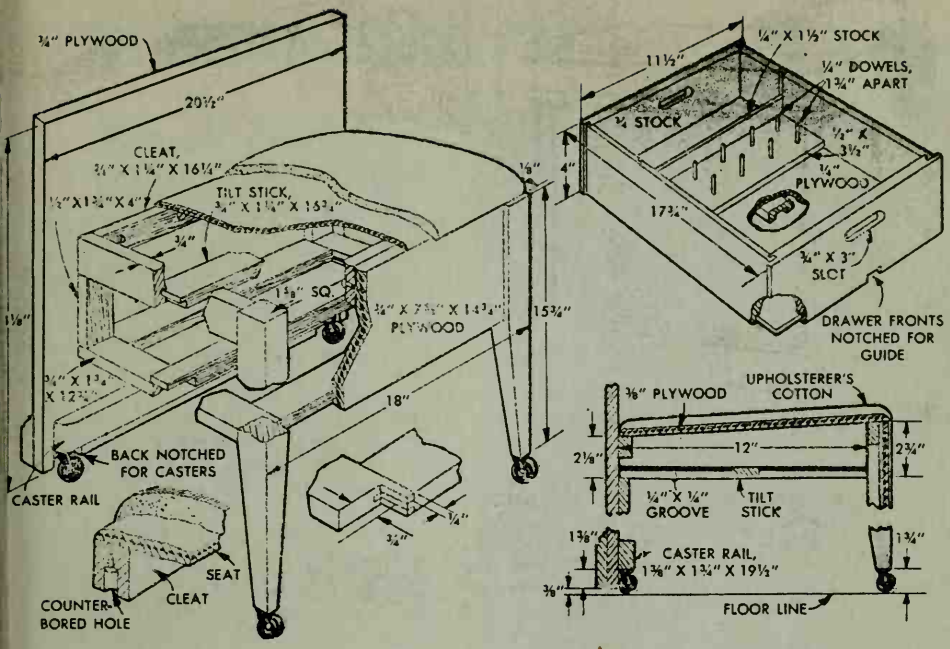
position and assembly of these parts will be seen from a study of the details, particularly sections A, B, C and E.

The base is built up by joining two open frames with mitered corners. The best way is to build the frames complete, then cut out one side of each to form the opening for the chair unit. The pieces cut out of the frames can be used later on to complete the design details on the back of the chair. The upper frame is rabbeted all around so that it fits over the top of the lower frame as in details A and B. The outer edges of the upper frame are molded and the top faces of all pieces except the front one, which forms the lower drawer rail, are grooved. Note also that the front and back members of the upper and lower frames are joined by cross members which complete the inner side of the drawer-pedestal base. The upper cross member is tenoned



Small cabinet without drawers





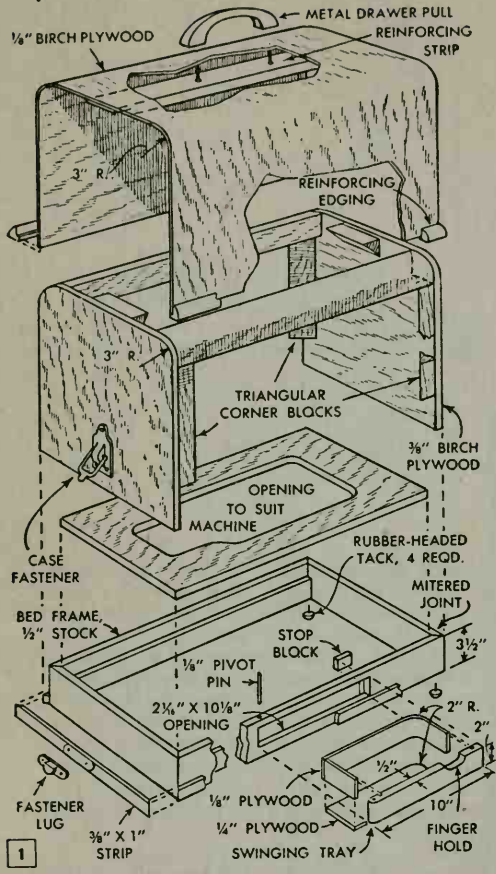
at the ends and grooved on the top face. The drawer rails, F, are grooved on both the front and back edges. The upper drawer frame prevents the top drawer from tilting downward as it is opened. The front edge of the front rail in this frame is hidden and therefore is not grooved. Make the drawer frames as complete units. Then fit them in the grooves cut in the side panels after the cabinet frame has been set up and before the front facings have been installed.

The cabinet top is built up as a unit and consists of two pieces of $1\frac{3}{16}$-in. plywood, the lower member serving as a subframe. The upper piece is cut into two parts, the smaller piece serving as a filler to build out the double thickness of the top over the drawer pedestal. In the assembly, it is face-glued to the subframe and the edges are planed flush. The larger piece is hinged to the opposite end of the subframe and forms a leaf which serves as a work surface when opened. The leaf is supported in the open position by a pull-out slide made as in the center right-hand detail, page 70. The top piece of plywood should be of the grade having both sides faced with selected veneer stock as the underside of the leaf will be exposed in use. An opening giving access to the drophead compartment is cut in the subframe and is partially closed by a hinged insert. This usually must be L-shaped, although some sewing-machine heads may require that it be made U-shaped. Before cutting the opening, check the dimensions of the sewing head carefully to make sure that you allow sufficient clearance. Cleats across the bottom of the subframe form rabbets into which the hinged insert closes.

On drophead sewing machines, the head usually is hinged at the back by means of special hinges which are mortised into the subframe at the edge of the opening. As a rule, you can use the old hinges which came with the head, but suitable hinges of the same type generally are available from the manufacturer of the machine. To locate the hinges, place the head in position with the insert in place. Mark the location of the hinges and also the rabbet on the inner edges of the insert. This takes the edge of the machine base flush with the top surface and can be cut with a router bit on the drill press. After cutting the rabbet and mortising the hinges, install invisible hinges for the insert. The drophead well, or compartment, is formed by attaching cleats to the inner faces of the end panel and the pedestal panel. Join these cleats at an angle as shown. Then nail two pieces of ¼-in. plywood to the cleats. Finish the cabinet with the band molding.

Construction of the drawers and the chair which rests in the cabinet are clearly detailed above and on the preceding page. Note that the base molding is continued along the lower edge of the chair back to match the molding on the cabinet itself.

SEWING MACHINE

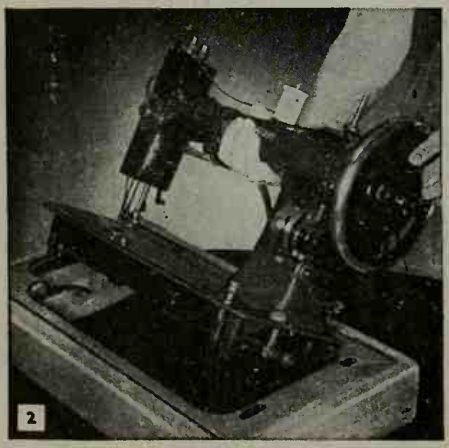


1

USING conversion kits now available, you can electrify that old treadle sewing machine and then make it over into a modern portable type by fitting the sewing head into an attractive cabinet. Almost any old sewing-machine head that is still in serviceable condition will do.

First remove the head from the cabinet and determine the over-all size of the mounting board, or base, to which the head is hinged. On some old machines the mounting board is in two parts. In this case, a new mounting board will have to be fitted. If it is necessary to make this part, use oak or birch plywood so that it can be finished attractively. Next, by measuring the sewing head, determine the required depth of the cabinet base, or bed frame, Fig.1. This is given as 3½ in., which is average, but you may have to change this dimension. Then measure the sewing head for over-all height, length and width. These dimensions, plus an allowance for clearance all around, will give you the inside dimensions of the cabinet hood.

Figs. 2, 3 and 4 show the cabinet base partly completed and the machine mounting board being fitted. As detailed in Fig. 1, an offset is formed all around the inside of the base on which the mounting board rests when the head is in position. If you have the necessary equipment,



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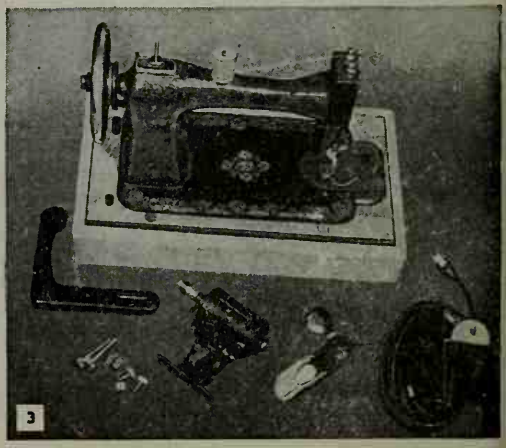
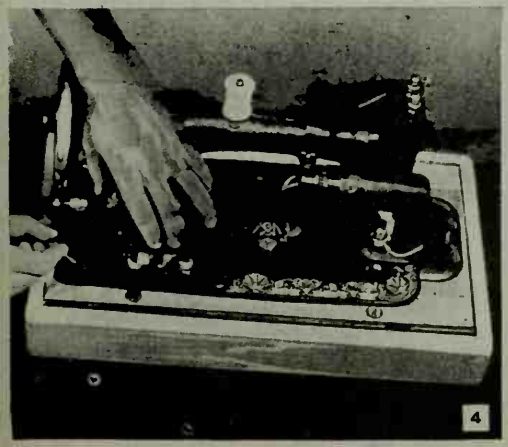


3

CONVERSION

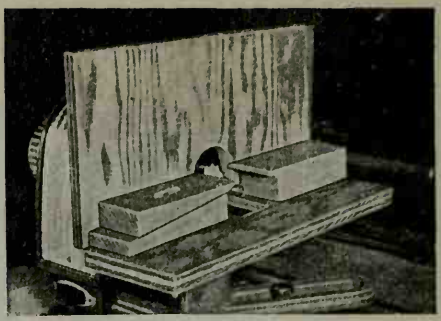
the extra pieces which form the offset can be omitted and the upper edges of the sides and ends rabbeted instead. The swing-out tray is optional. On some types of sewing heads it is not possible to install the tray unless the base is made deeper so that the tray will clear when closed. The endpieces of the cabinet hood are cut from ⅜-in. plywood with a 3-in. radius at the upper corners. If desired, the hood can be made with a fully rounded top instead of the flat top detailed. The end panels are glued and bradded to the spreaders. Triangular corner blocks are glued flush with the edges of the endpieces at the top and sides. Then the plywood covering is dampened at the points where it will take the bends and is bradded and glued in place. After the glue is dry, set the heads of the brads below the surface and fill the holes with a wood filler. Install a reinforcing strip of hardwood under the point where the carrying handle will be attached, as in the upper detail, Fig. 1. Attach the handle with screws driven up from the underside of the hood through the reinforcing strip.

Now, make a trial fit of the hood as in Fig. 5. It should fit over the bed frame without binding. This determined, glue rabbeted strips to the bottom edges of the hood to protect the edges of the thin plywood. These strips match the ⅜ x 1-in. strips glued to the outside of the bed frame, as in the lower detail, Fig. 1. Varnish all exposed parts in the natural color of the wood. If birch or other close-grained hardwood is used, no stain or filler will be necessary. Instructions supplied with the motor kit, Fig. 3, will indicate clearly how to install and operate the unit. Have the kit on hand before building the hood so you can make allowance for hood clearance.

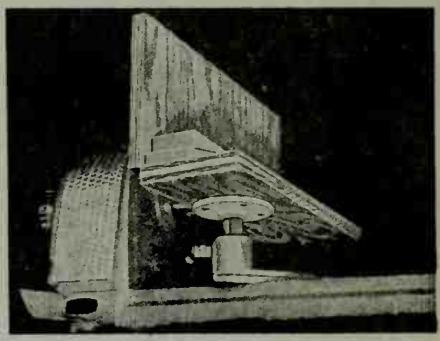


SHAPER ATTACHMENT FOR THE LATHE

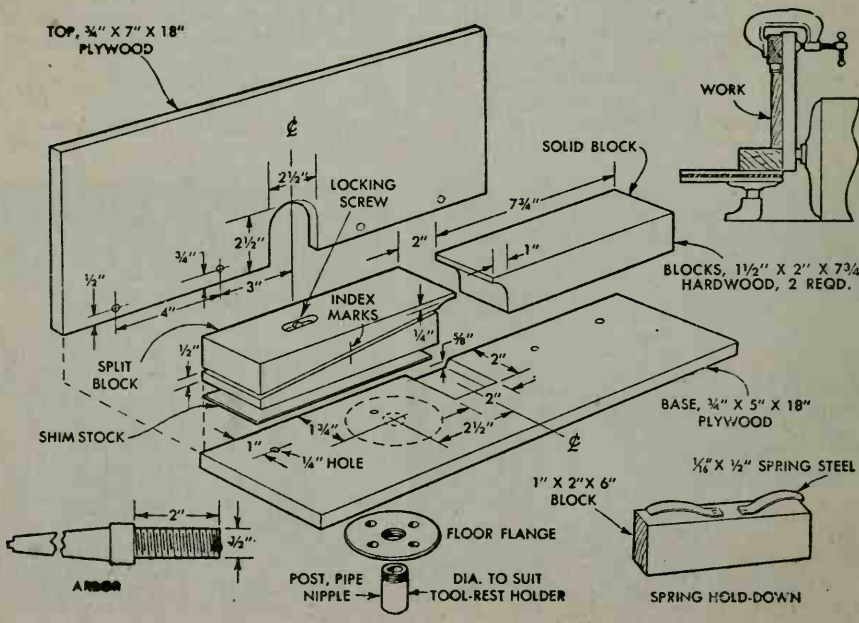
FOR A FEW cents, plus some scrap lumber, you can add a practical shaper attachment to your lathe and thus equip your shop for decorating table and chair legs, fluting, beading and making ornamental moldings. The only cash outlay needed to build the the attachment is for the floor flange which holds the shaper in the tool-rest holder. The base and back are made of ¾-in. plywood, while the blocks on which the work rests are 1½ x 2 x 7¾-in. hardwood. One of these blocks is split diagonally so it can be adjusted to compensate for full-width cuts that are made with a straight-face shaper cutter. Index marks are scribed along the junction line of the two halves of this block. At the time this is done, the left and right-hand blocks must be in perfect level alignment. Once the assembly is mounted on the tool-rest holder, the base is checked for alignment with the arbor. If the alignment is not true, shims are inserted between the floor flange and the base. Several holding blocks are made, as indicated in the detail, and clamped against the backboard to hold the work in position while shaping.



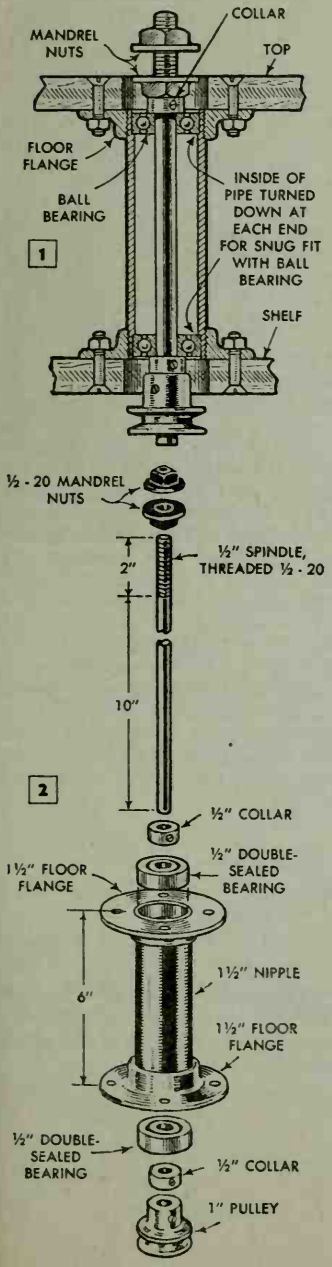
The completed shaper on the lathe and ready to go to work. Note that a shim is inserted under left block to compensate for saw cut when block is split

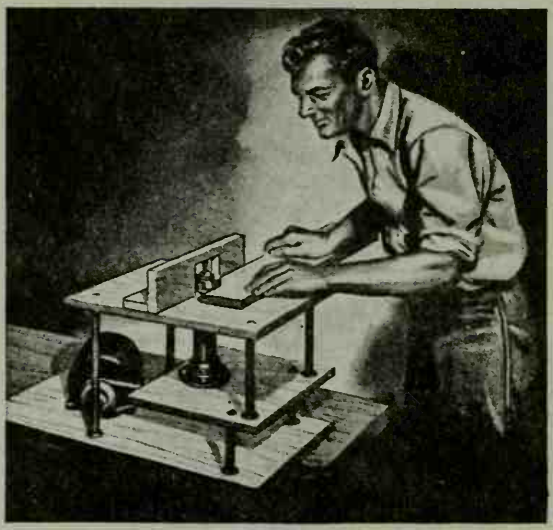


Diameter of floor flange and of pipe which threads into it depends on the size of the tool-rest holder



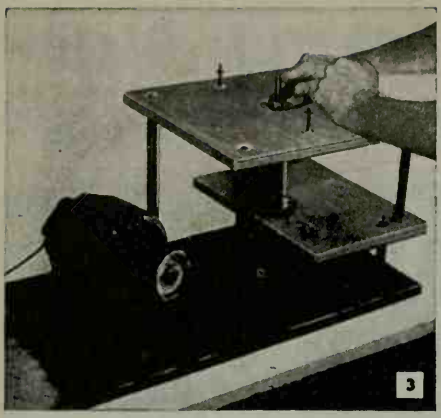
SHAPER FOR SMALL SHOP
assembled from pipe and plywood

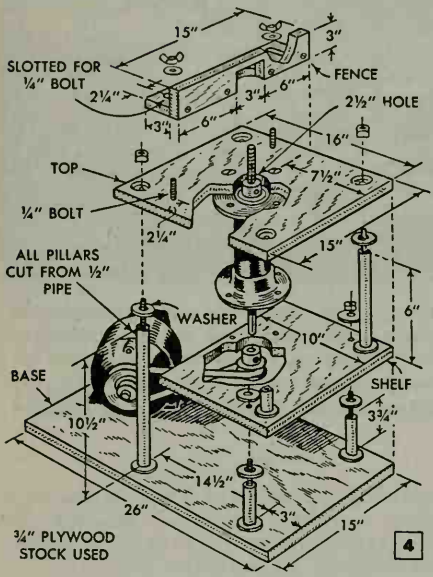




Quarter-horsepower motor has ample power for homeshop use, and gives high speeds necessary for smooth finishes. A simple fence suitable for straight work can be made with the shaper, or an adjustable shaper fence can be purchased

HOME CRAFTSMEN and small woodworking shops having only occasional use for a shaper will find this unit practical and inexpensive to build. It handles any standard three-lip shaper cutter having a ½-in. hole and also safety cutterheads with removable knives. The spindle is mounted on sealed ball bearings which permit it to be driven at the high speeds necessary to produce smooth work. A ¼-hp. motor supplies ample power for average work. The motor is mounted in the horizontal position and drives the spindle with a half-crossed round belt. By simply shifting the belt, the rotation of the spindle can be reversed, a requirement on some types of shaper work where separate cuts must be made on the top and bottom edges of the work. The spindle is made from a 12-in. length of ½-in. steel shafting. Cut a ½-in. No. 20 thread on one end for a distance of 2 in. It is best to cut this thread in a lathe if possible, as it is important that the thread be cut true with the axis of the spindle. The spindle housing, Figs. 1 and 2, is made from a 1½-in. pipe nipple 6 in. long, and two 1½-in. pipe floor flanges. The pipe nipple is bored at both ends to house the ball bearings, Fig. 1. This must be done in a lathe. To assemble the spindle unit, press the bearings in place

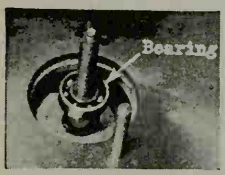




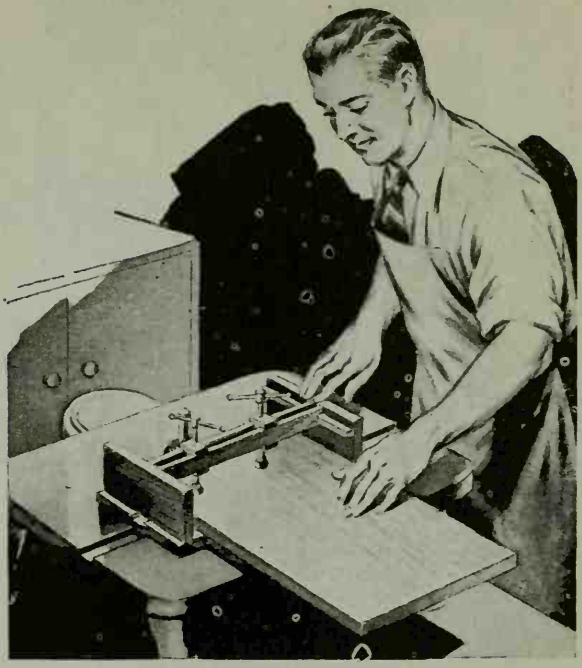
and then tighten a ½-in. collar on the shaft just below the lower end of the thread. Pass the shaft through the bearings and tighten a second collar on the unthreaded end. This collar must fit snugly against the inner race of the bearing, Fig. 1. Then screw a floor flange on each end of the pipe housing but do not draw these up tightly. Now, note the manner of assembling the three-part frame which provides a table, a shelf support for the spindle assembly and a base for the motor, Figs. 3 and 4. The pipe pillars, or posts, which also serve as spacers, are cut from ½-in. pipe to the lengths given. The base, shelf and top are cut from ¾-in. plywood and holes are drilled and counterbored in the positions indicated. Bolt the shelf to the base first, passing the bolts through holes drilled in the base, through the pipe spacers and through the holes drilled in the shelf. Support the shelf in the level position and set the spindle assembly in place. Then locate the table over the spindle and assemble all spacers between the top and the shelf. Finally, assemble the long spacers between the top and the base and draw the nuts down finger-tight. Now check to see that the spindle fits correctly between the shelf and the table. If necessary, adjust it to the proper length by turning the flanges off or on the nipple. Then bolt the spindle assembly in place and tighten all the spacer bolts uniformly. Note that washers are placed over the ends of the spacers to prevent crushing the wood when the bolts are tightened. Locate the motor on the base by lining up the motor pulley with the axis of the spindle. A 3-in. pulley on a 3450-r.p.m. motor will give the correct spindle speed. Use either a round belt or a ⅜-in. V-belt. A simple fence suitable for straight work can be made as detailed in Fig. 4, and an adjustable shaper fence may be purchased if desired.

Bearing Depth Collar for Shaper Prevents Scored Work

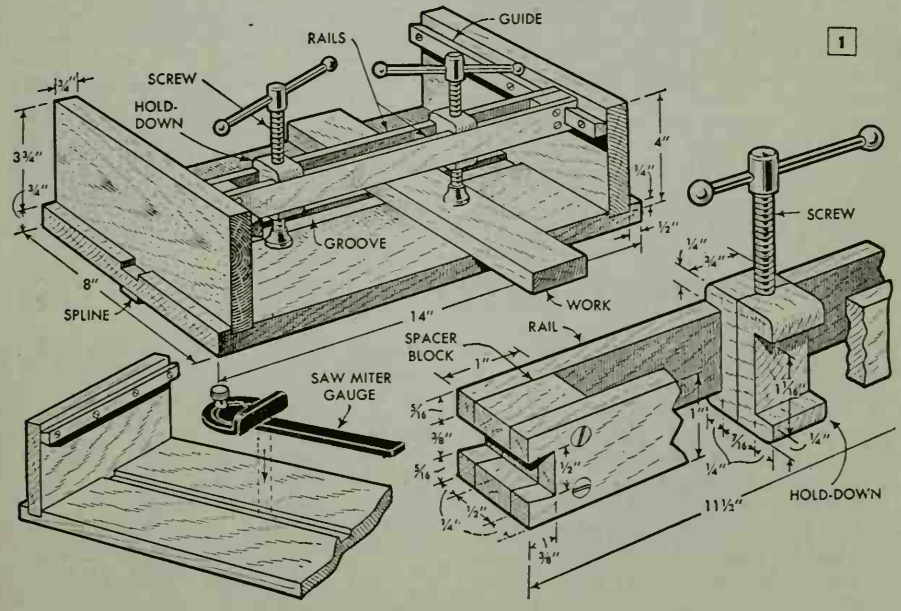
When shaping irregular work, a common ball bearing substituted for the standard solid depth collar will effectually prevent the work from being scored or scorched due to friction of the spinning collar. The bearing allows the work to "roll" with the free outer race. In the shaping of plastics, this method is especially desirable where the bearing of the work against a solid collar would have a tendency to burn the edges. Various sizes of bearings will allow cutting of the most common depths.

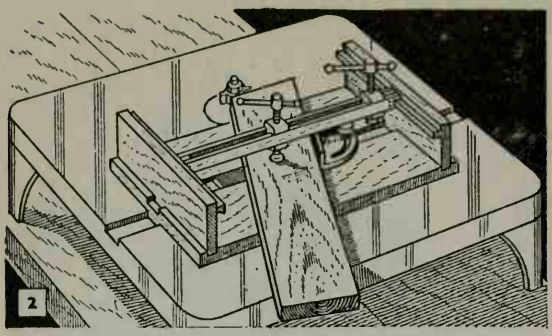


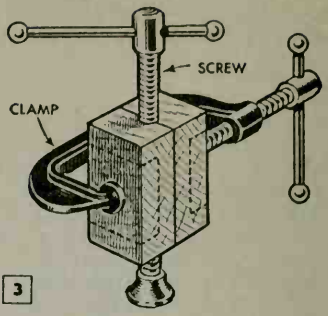
SHAPER JIG FOR END CUTS



WHEN running a molding cut across the end grain on wide stock, it is difficult to hold the piece securely against the miter gauge with the hands alone, particularly on a small shaper table. Inaccurate work is likely to result because of the tendency of the stock to creep away from the cutters. This type of work is handled safely and accurately in the special jig detailed in Fig. 1. The jig consists of a base with two endpieces set in grooves and glued and screwed in place. Note that the base also is grooved lengthwise at the center, the width and depth of the groove being determined by the width and thickness of the miter-gauge spline. The miter gauge is







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used to guide narrow pieces, as in Fig. 2, where the work is positioned at an angle so that a molding cut can be run across the end. A hardwood spline screwed to the bottom piece, as in Fig. 1, fits in the groove in the shaper table to guide the jig. Care must be taken when fitting this spline to make sure that it is located parallel with the inner edge of the bottom piece and also that it is positioned at right angles to the endpiece. Countersink the screws.

The hold-down screws are taken from old C-clamps. On most types of C-clamps it is only necessary to bend the tabs on the swiveling pad outward and the pad will slip easily off the ball end of the screw. Then the screw can be turned out of the clamp frame. These screws are then made to tap threads in hardwood hold-down blocks by turning them into tapholes drilled in the blocks, Figs. 1 and 3. Determine the size of the taphole required by measuring the diameter of the screw at the bottom of the threads. On certain types of C-clamps the screw can be removed only by cutting away the frame of the clamp. In this case, two blocks must be used to make each hold-down. First clamp the blocks together and drill the taphole. Then clamp the blocks together over the screw as in Fig. 3 and turn the screw back and forth to form the threads. After the threads are cut in the wood in this manner, glue the blocks together with the screw in place as in Fig. 3. Next, notch the blocks to fit the side members of the sliding bar, as in the lower right-hand detail in Fig. 1. The hold-downs should slide easily when the two bars are assembled with spacer blocks as shown. Cut dovetail notches or grooves in the ends of the assembled unit. Then make dovetail slides from hardwood and screw these to the inner face of the endpieces. The dovetailed ends of the bar fit over these slides as shown in the assembly view in Fig. 1. Check the assembly for free movement along the full length of the dovetail slides. To use the jig, place it in position on the shaper table, locate the stock in line with the shaper cutters with one edge bearing against the rear endpiece and tighten either one or both of the hold-down screws to hold it firmly in position. Slide the jig slowly forward until the work has passed the shaper cutters. Then slide the jig off the table and remove the work before replacing the jig on the table. If the piece requires more than one pass to complete the cut, replace the jig, with the work still in place, on the forward edge of the table and adjust the shaper spindle before running the next cut.

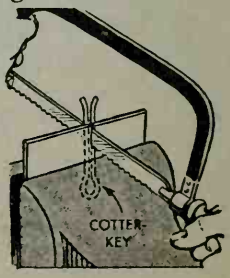
SHEET METAL CUTTING

Channel Formed by Wood Strips Aids in Cutting Sheet Metal

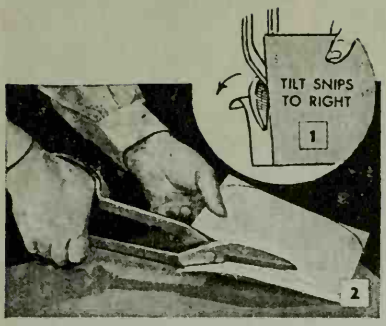
If you have a heavy piece of sheet metal to cut and only a pair of light shears at hand, a channel formed by nailing two spaced wood strips to the floor or bench top will help. If one handle of the shears is placed in the channel, it will keep them from tipping when pressing down hard with one hand to operate the shears. Also, the channel will serve as a guide in cutting straight across the metal sheet.

Cotter Key in Vise Guides Saw When Cutting Sheet Metal

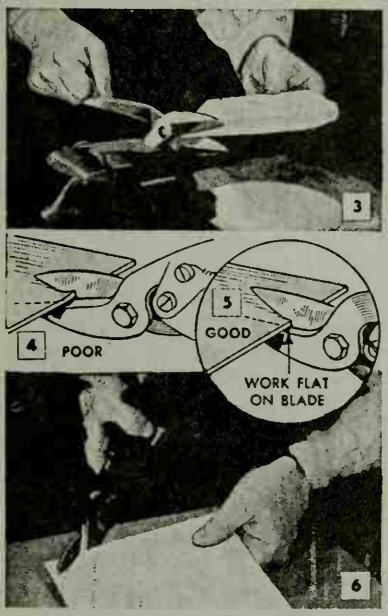
To help stiffen thin sheet metal held in a vise and guide the saw for a straight cut, one mechanic employs a cotter key as shown. The key is clamped behind the metal where the legs serve as a saw guide.



SHEET METAL CUTTING



Snips should be held square with work, except aviation type which cut best with right tilt. Below, vise mounting aids in cutting thick stock

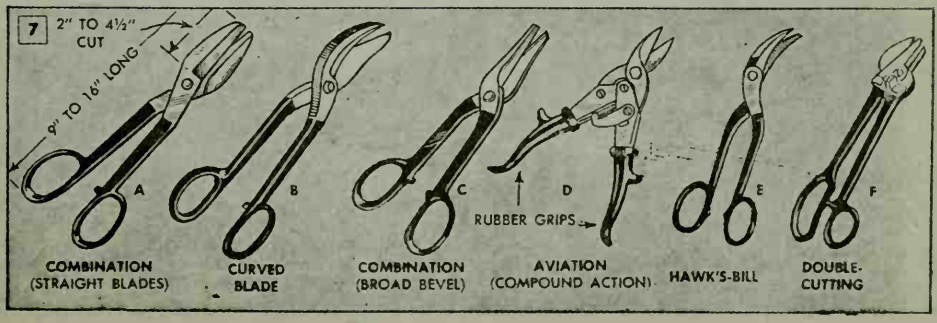


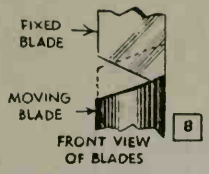
JUST AS IN woodworking, the fundamental process in working with sheet metals is cutting the stock to specified dimensions or shapes. In some instances, such as making ornamental cutouts and plain overlays, the whole job is confined to cutting operations, but more often cutting is simply a preliminary step to bending, spinning, hammering and other operations needed to complete the project.

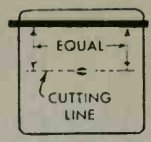
Snips are basic tools: Whatever other sheet-metal cutting tools you may have, there is always need for a pair of snips. Several popular styles are shown in Fig. 7, of which the combination snips, A and C, are favorite all-purpose tools for straight or curved cutting. Aviation-pattern snips with compound leverage are rapidly gaining in popularity. These snips make a clean cut with much less hand pressure than required for regular snips. When using snips, the blades should be held at right angles to the work, as shown in Fig. 2. If you run off the line, a slight tilt to the right, Fig. 1, will free the work pressure and allow the blades to return to the line.

Snips with a broad cutting bevel, C and D, Fig. 7, work best if tilted a little to the right throughout the cutting operation. Fig. 5 shows how the right tilt locates the lower face of the work flat on the blade. When cutting heavy materials with snips, a one-handed action with the free handle held in vise, Fig. 3, will give extra power.

Slitter and portable shear: These two are power tools and both work on the same principle, having one fixed and one moving blade, as shown in Figs. 8 and 13. The slitter is a bench tool. In a small unit, it is powered with a ¼-hp. motor which is belted to the machine with driving and driven pulleys of the same size, giving 1725 strokes per minute. It is a fast-cutting machine





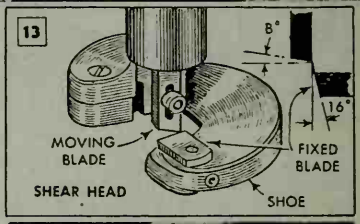


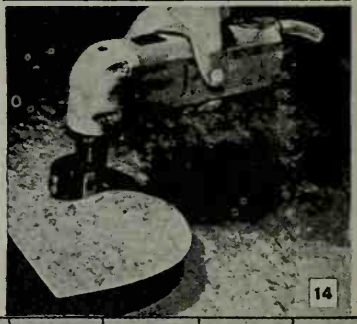
SLITTER AND PORTABLE SHEAR are fast cutters. Both work on the same principle, each having one fixed blade and one moving blade

when properly operated but requires some practice in manipulating the work and adjusting the blades. The blades will cut best if set tight on the infeed side and slightly open at outfeed side, as shown in the top view, Fig. 10. The feed rate should be smooth and uniform and the operator must guard against any tendency to lift the front edge of the work as this will invariably cause jamming.

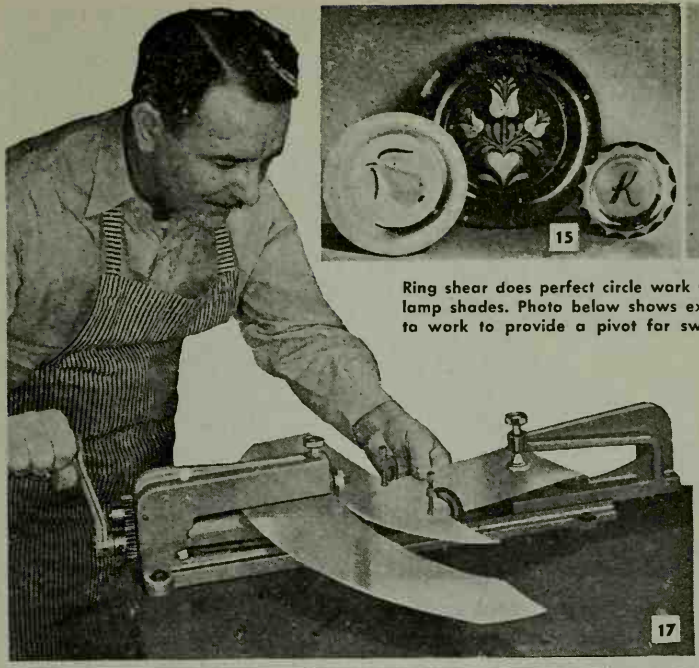
It is practical to fit a plywood table over the regular metal table and in this way gain needed work surface for large pieces. Although straight cutting with a fence is fast and accurate, it is important that the fence be set parallel with the flat side of the blades, Fig. 9. If the fence is only slightly out of line, the work may jam.

The cutting head of the portable shear is detailed in Fig. 13 and the shear is pictured in Fig. 14. This is a convenient, fast-cutting tool and the most important point in operating technique is to keep the work flat on the fixed blade. It will make inside cuts but requires a rather large hole in the stock to admit the shoe. Neither shear nor slitter is capable of





Tool Data	SNIPS	SLITTER	PORTABLE SHEAR	PORTABLE NIBBLER	HAND PUNCH	RING SHEAR	BAND SAW	JIG SAW
THICKNESS CAPACITY	21 GA. (.032")	20 GA. (.035")	18 GA. (.049")	18 GA. (.049")	20 GA. (.035")	20 GA. (.035")	ABOUT 3"	ABOUT ¼"
CUTTING SPEED per Min.	ABOUT 24"	UP TO 120"	UP TO 120"	UP TO 80"	UP TO 40 STROKES	UP TO 120"	UP TO 120"	ABOUT 30"
MINIMUM RADIUS	ABOUT ¾" (AVIATION)	ABOUT 3"	ABOUT 3"	ABOUT 2"		ABOUT ¾"	⅛" (⅛" BLADE)	WILL MAKE ANY CUT
KIND OF WORK	GENERAL	GOOD FOR FAST ROUGH WORK	GENERAL	STRAIGHT AND CURVES --GOOD FOR NOTCHING	HOLES AND SHORT STRAIGHT CUTS	GOOD FOR CIRCLES AND RINGS	GENERAL— FAST CUTTING	INTRICATE CUTOUTS— INSIDE CUTS



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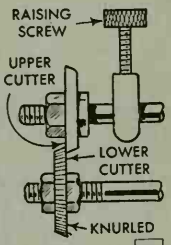
Ring shear does perfect circle work needed for plates and lamp shades. Photo below shows extension strip clamped to work to provide a pivot for swinging large segment



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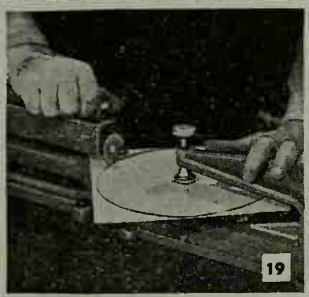

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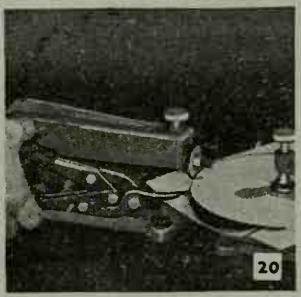

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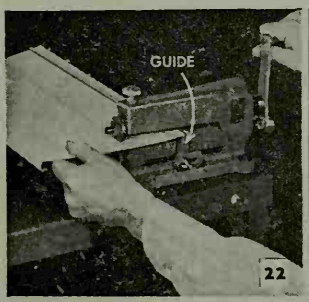
Circles are cut by using a pivot, which is an accessory to the shear. Cut may be started at edge of work, as in bandsawing, or top cutter can be forced through work at any point. To prevent distortion, inside cuts are made with minimum overlap of the cutters. On outside cuts, snip away the waste as cut progresses



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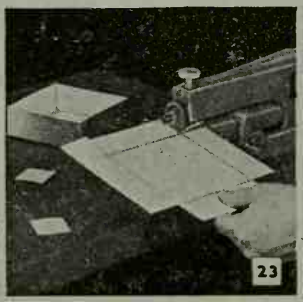

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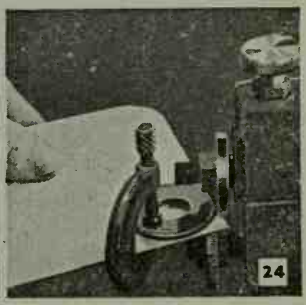

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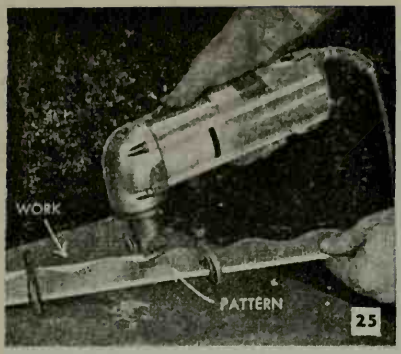
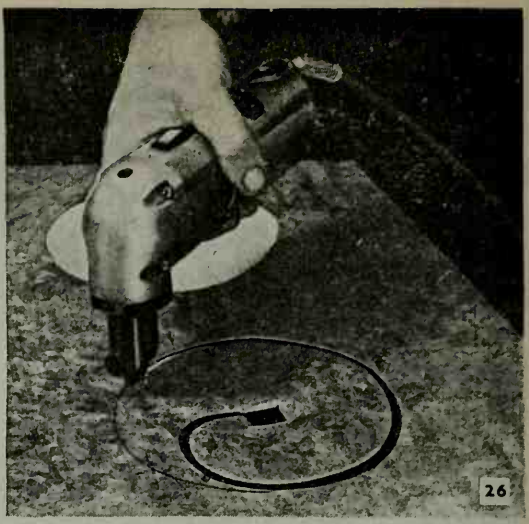
Straight cuts can be made freehand by following a pencil line, but a better way is to improvise a guide as in left-hand photo. Center photo shows how notches are cut to form box corners. Right-hand photo shows how a curved guide can be used to form a true radius. In this case, an ordinary washer served the purpose

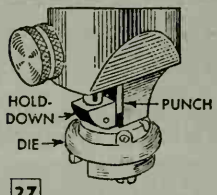




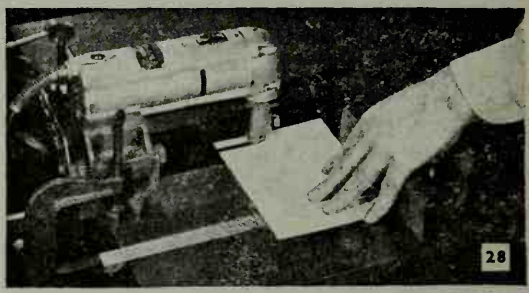
making sharp curves. Such work must be done by making a series of tangent cuts to the dimension line and cutting away the waste.

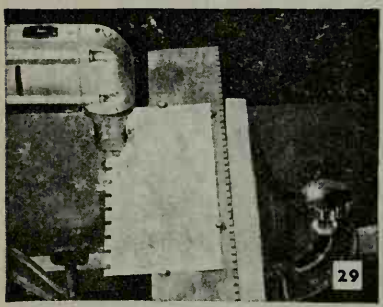
Ring shear: One of the best tools for cutting sheet metal is the ring-and-circle shear, Fig. 17. It cuts fast, is noiseless and does perfect work in cutting circles and rings needed for many metal projects. Fig. 18 shows the cutting head, consisting of two hardened steel wheels which are interchangeable. The knurled wheel will leave a slight track on the work but the interchangeable feature permits mounting this wheel to run on the waste stock.

When cutting a circle, the work is clamped in the pivot jig, after which the raising screw is turned to force the cutter through the work, Fig. 19. After that, you just turn the crank. It usually is advisable to cut away the waste, or offfall, in sections, Fig. 20. Inside cuts are made in the same manner, as shown in Fig. 21. When used with the guide, Fig. 22, the ring shear

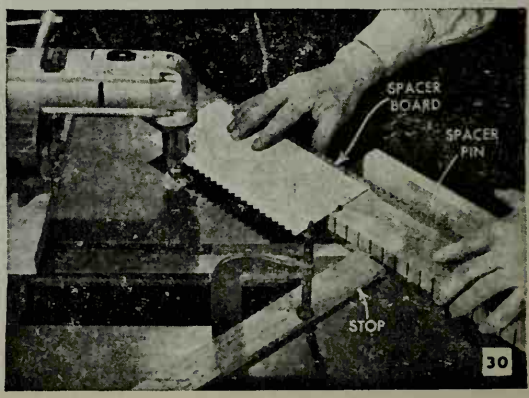


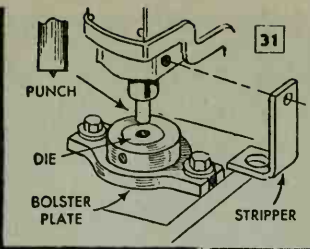
A portable nibbler can be used freehand or with a pattern as in the upper left-hand photo. Square housing permits unit to be mounted in vise as in photos

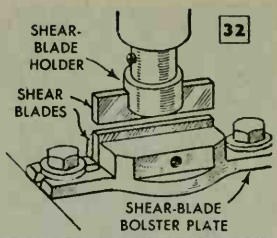


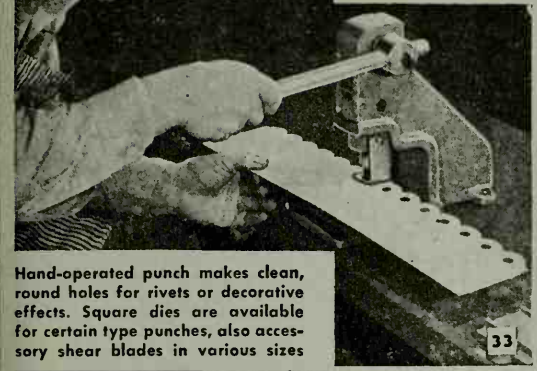


Used with a spacer board and stop on circular-saw table, the nibbler can be set up to make a variety of attractive notched borders. Work is held in place with thumbtacks

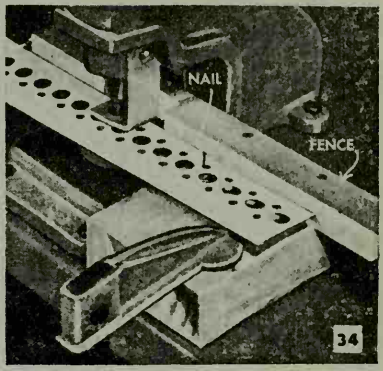


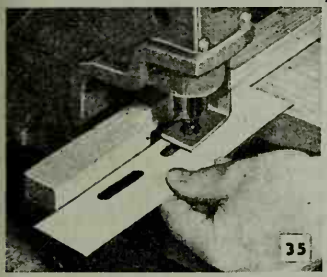




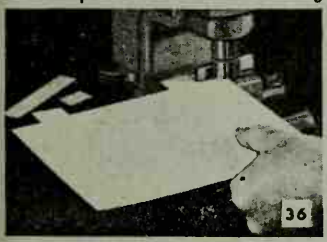


Hand-operated punch makes clean, round holes for rivets or decorative effects. Square dies are available for certain type punches, also accessory shear blades in various sizes

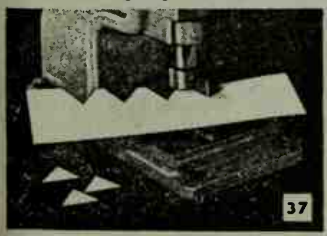




A hand punch does accurate slotting



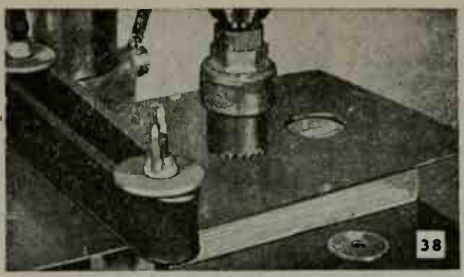
Above, cutting in from edge with shear. Below, notching edge with shear blade



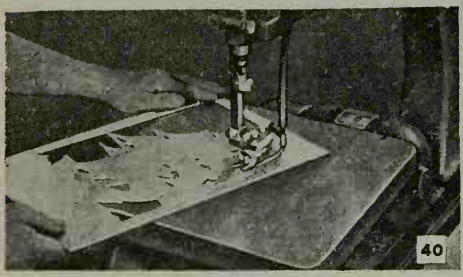
does clean, straight cutting. Fig. 23 shows a notching operation and Fig. 24 shows how a pattern can be used. In this instance a washer serves as a guide for rounding corners.

Portable nibbler: Punching tools, which include the nibbler, Fig. 26, and the hand punch, Fig. 33, work with the least distortion of the material and make the cleanest edge of all metal cutters. The portable nibbler is simply a power-operated punch. As shown in Fig. 27, the die is carried on an extension of the frame, while the punch oscillates rapidly up and down through the die. In the portable tool, the most popular type of punch is a rectangular shape measuring 1/16 x 1/4 in., with rounded edges. The slight serrations left by this type of punch are so small that the edge requires a minimum of finishing. Because of its easy portability, the nibbler is widely used in cutting large patterns and cutouts on sheet sizes which are impractical to handle on a bench machine. But it does the smaller, more intricate jobs equally well. Cutting without distortion and with no exposed parts, it will work circles down to the size of a dime. Inside cuts can be made with a 1-in. starting hole, as in Fig. 26. The use of a metal or wood pattern is practical and fast repetitive work can be done in this manner, the edge of the cutterhead riding the pattern as in Fig. 25. Many portable nibblers have a square motor housing to permit vise mounting. A good setup of this kind can be made on the circular-saw table, as shown in Fig. 28. With the work thumbtacked to a spacer board, the saw-table setup is ideal for ornamental notching, as shown in Figs. 29 and 30.

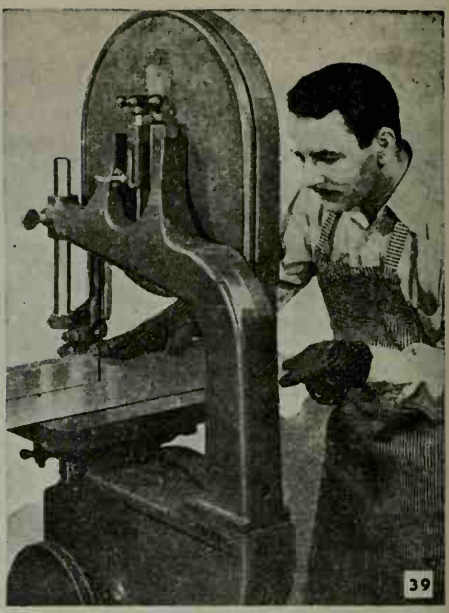
Hand-operated punch: This is one of the handiest tools in the shop and does a variety of jobs with suitable accessories. Its prime job is to punch round holes in sizes from 1/8 to 1/2 in., advancing by sixteenths. Fig. 31 shows the setup. Each punch has a tiny point at



Hole saw is useful drill-press accessory fc ..i- ting clean holes. Also is used with portable drill



Jigsaw is best for intricate cutouts in sheet metal. A 15-tooth blade does rapid work in medium stock



Bandsaw used as friction saw cuts fast and accurately on sheet metals of all kinds up to ⅛ in. thickness

the center, and this centers on punch marks made on the work. Instead of prick-punching each center mark, it is possible in repeat patterns to use a fence and guide pin, as shown in Fig. 34. After the first 4 in. of the pattern have been punched out in the usual manner, succeeding holes can be worked very rapidly. Employing a series of punched holes with the work guided along a fence, the hand punch does excellent slotting, as shown in Fig. 35. Unlike a similar operation done with drills on the drill press, the holes can be as closely spaced as desired, without distortion or runover.

A handy accessory for the hand punch is a set of shear blades, Fig. 32. With these you can do straight-line cutting, notching and internal cutting. The shear-blade bolster plate can be used in either of two positions, as shown in Figs. 36 and 37, to suit the work.

Bandsaw and jigsaw: More familiar to the average worker, these power tools do excellent work in metal. Ordinary wood or metal-cutting bandsaw blades run at woodcutting speeds can be used to cut aluminum up to 1/16 in. thick. For fast cutting of heavier black and galvanized sheet metal up to ⅛ in. thick, the technique of friction sawing on the bandsaw is excellent. This is done with a regular metal-cutting blade, 18 teeth per inch, run at 2800 to 3000 f.p.m. Galvanized sheet stock can be cut in this way as fast as the hand can push the work, Fig. 39. For conventional bandsawing of sheet metal, the speed should be reduced to approximately 200 f.p.m., using a 24 or 32-tooth blade.

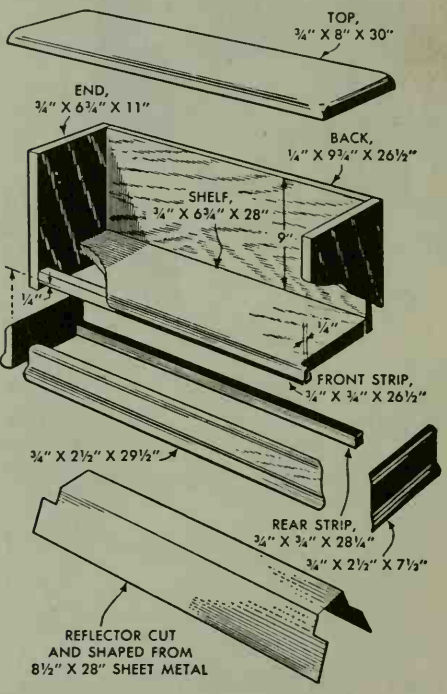
The jigsaw cuts much more slowly than the bandsaw but is the best tool for making intricate cutouts involving short-radius curves. The fastest cutting is obtained with a hardened and set metal-cutting blade with about 15 teeth per inch. For finer but slower work, 30 or 32-tooth blades should be used. Medium speed can be used for soft metals. But use only the slow speeds for sheet steel.

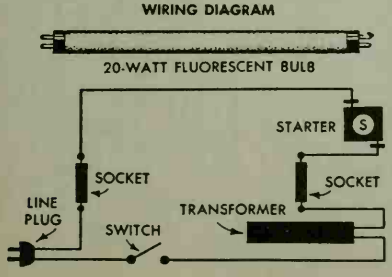
Other equipment: The tools described fall far short of covering the full line-up of sheet-metal cutting tools. A worth-while extra is a set of hole saws, which can be used in an electric portable drill or drill press, Fig. 38, for cutting accurate holes in sheet metal. Of the various methods, snips, ring shear and punch are the 1-2-3 selection—assuming that you already have jigsaw and bandsaw. ★ ★ ★

SHELF-LIGHT

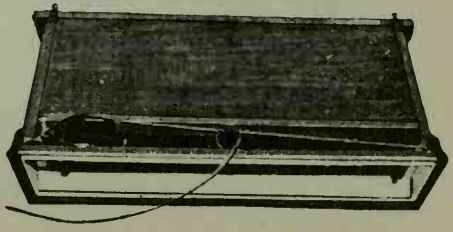
After fluorescent bulb has been removed, wall shelf can be set under window to double as floor bookcase

STORAGE space for more than 20 books along with plenty of soft light for reading or writing are the features of this attractive shelf-light which is conveniently mounted on the wall right over a desk. The shelf is of simple box construction, the ends of the bottom piece being cut so that the front edge extends across the edges of the sides. Note that the distance between the underside of the shelf and the lower edge of the light-canopy molding must be at least 3 in., which is the depth necessary to conceal the 20-watt fluorescent tube. The sheet-metal reflector is bent lengthwise, as shown, the bend at the front of the reflector being about 3½ in. from the edge and the bend at the rear about 2¼ in. from the edge. The rear bend should be rather sharp, almost at right angles if desired, and the front is bent just enough to spread the reflector across the depth of the shelf. The fluorescent lamp is wired as in the diagram and a canopy-type switch is installed in the end molding. The transformer, or ballast, is bolted to the rear of the reflector so it fits beneath the bookshelf as in the lower right-hand photo. After the sockets and starter are attached to the reflector with machine screws, the reflector is screwed to the shelf bottom, the lower edge of the front molding and to the rear strip.

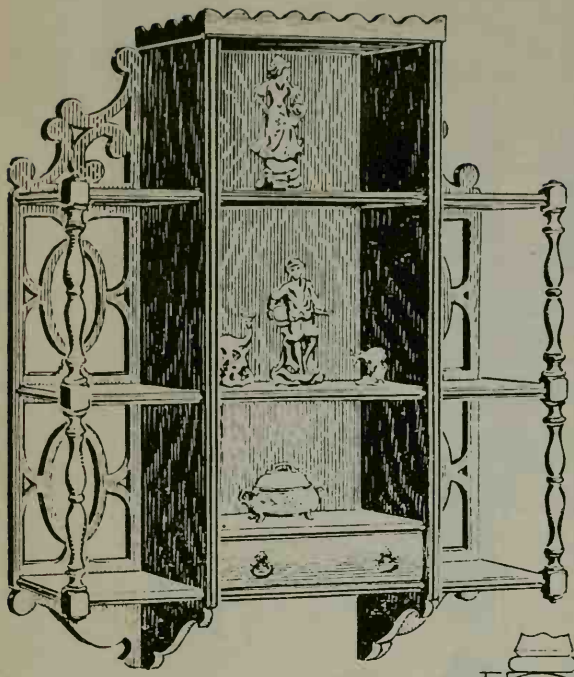


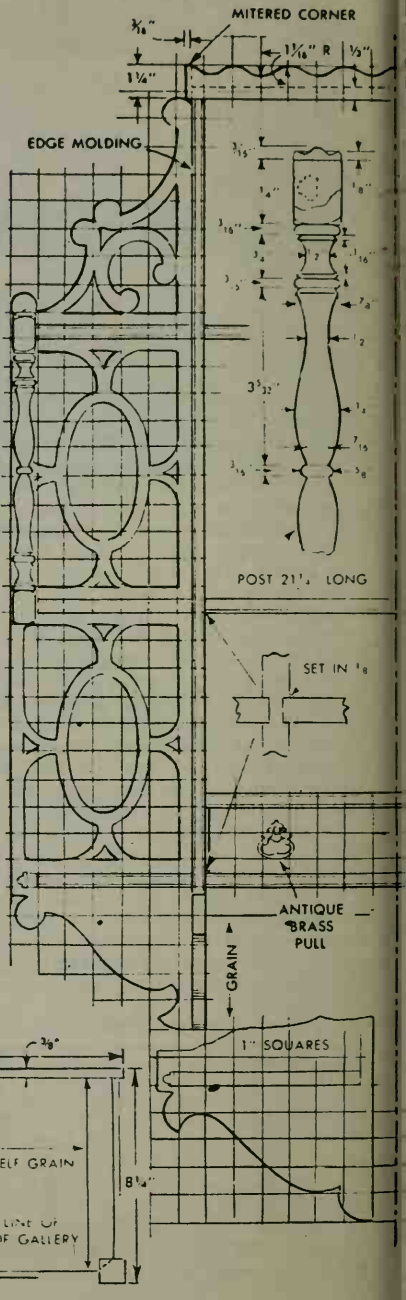


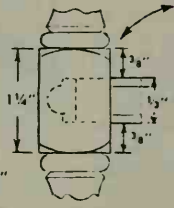
Baseboard outlet shown in center of the canopy, below, provides connection for an electric desk clock

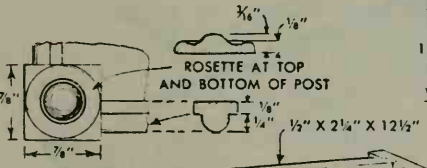


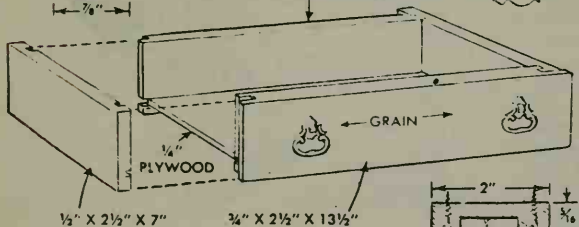
SHELVES

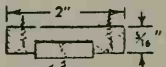


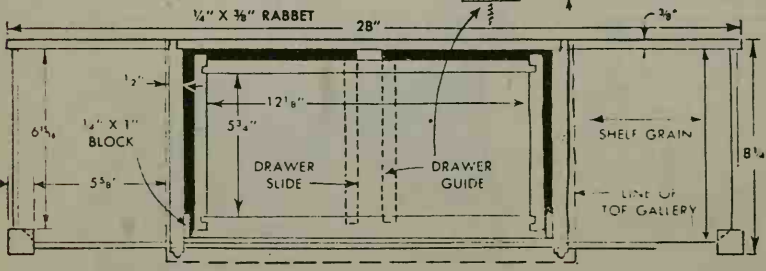

MITERED CORNER
EDGE MOLDING
POST 21¼ LONG
SET IN ⅛
ANTIQUE BRASS PULL
GRAIN
1" SQUARES


⅜"
1¼"
⅜"


3/16"
⅛"
ROSETTE AT TOP AND BOTTOM OF POST
⅞"
⅛"
¼"
⅞"

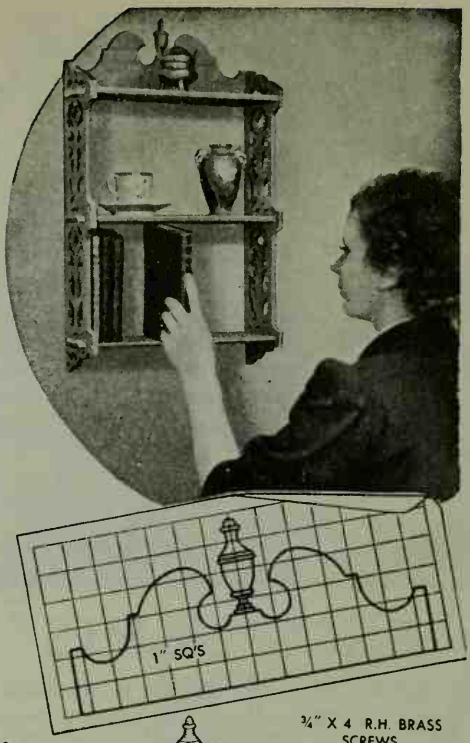

½" X 2¼" X 12½"
GRAIN
¼" PLYWOOD
½" X 2½" X 7"
¾" X 2½" X 13½"

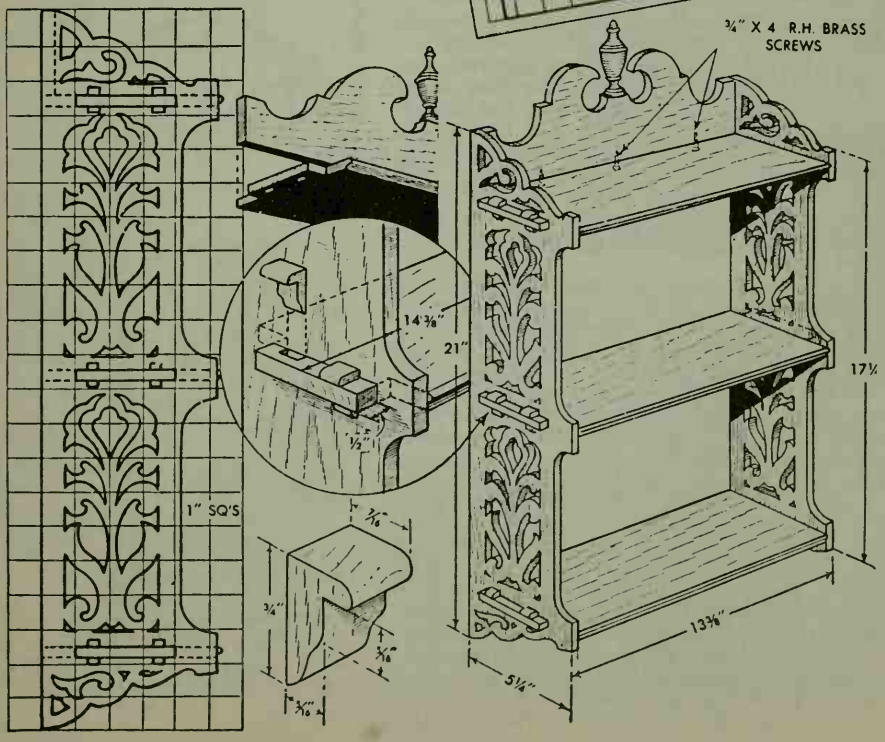

2"
3/16"

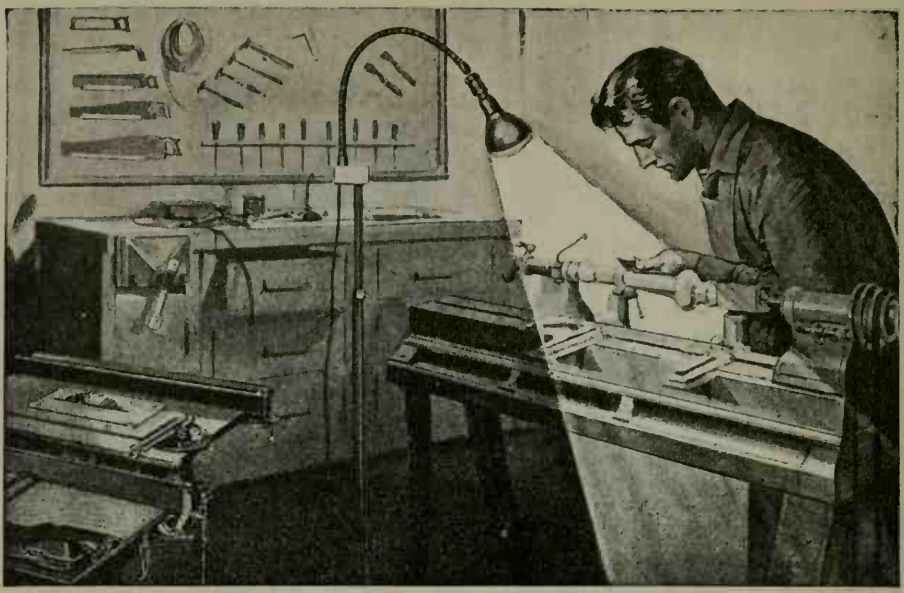

¼" X ⅜" RABBET
28"
⅜"
½"
12⅛"
6⅛"
¼" X 1" BLOCK
5¾"
⅞"
5⅜"
DRAWER SLIDE
DRAWER GUIDE
SHELF GRAIN
8¼"
TOP GALLERY

SHELVES

GRACEFUL and serviceable, this wall shelf is just the right size for bric-a-brac, yet is large enough to hold several books. It is scrollsawed from ¾-in. plywood, and the shelves and sides are joined by wooden pegs. These are fitted snugly in slots cut in projecting ends of the shelves and are glued in place as shown in the circular detail. The pediment, of heavier stock, is cut to shape according to the cross-hatched pattern and is held by screws driven through the upper shelf from the underside. To hold the pediment rigid, brads can be driven into it through the sides. A turned finial then is split, one half being used as an ornament. This is held by a tenon or a short length of dowel.





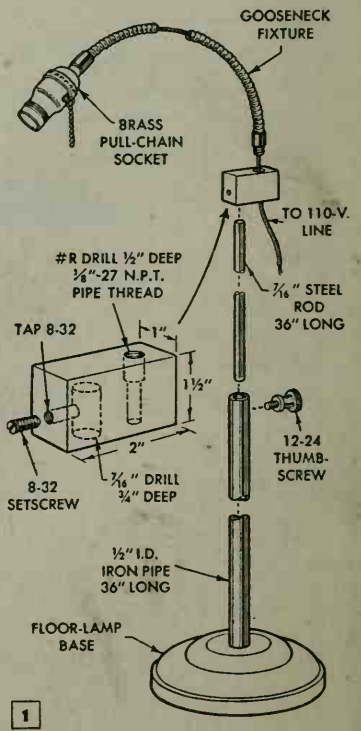


SHOP LIGHTS

ALTHOUGH the human eye is adaptable to varying light conditions, it's better to provide a good source of illumination when working in a shop or around machinery where accuracy and precision are essential. The two shop floor lamps described here are designed to give the kind of light that will avoid eyestrain and to direct it where needed. In addition, by using special bulbs now on the market, the lamp shown in Fig. 1 will do multiple duty by serving as a source of infrared, ultraviolet and photographic light. The baby spotlight, Fig. 2, also performs well in the photographic studio.

Of the two lamps, the one with the gooseneck adjustment is easier to make because it requires fewer parts, and in some respects it is more versatile, due to the fact that many different types of bulbs can be used with it. The base should be heavy and compact. The cast-iron standard or base taken from an old floor lamp will serve—the heavier the better. Probably it will be necessary to bore and tap the hole in the base to fit the threads on the ½-in. pipe that serves as the lower half of the upright. The upper half, which serves as the sliding member, is a length of 7/16-in. rod approximately 36 in. long, as is the pipe. The diameters of these two pieces do not have to be held exactly, but they should be sufficiently rigid and not fit together too loosely. Drill and tap the pipe for the thumbscrew that adjusts the height of the lamp.

A metal block that serves as a swiveling member for the gooseneck fits on top of the rod and is locked in position with a headless setscrew. First, machine the outside dimensions and then drill and



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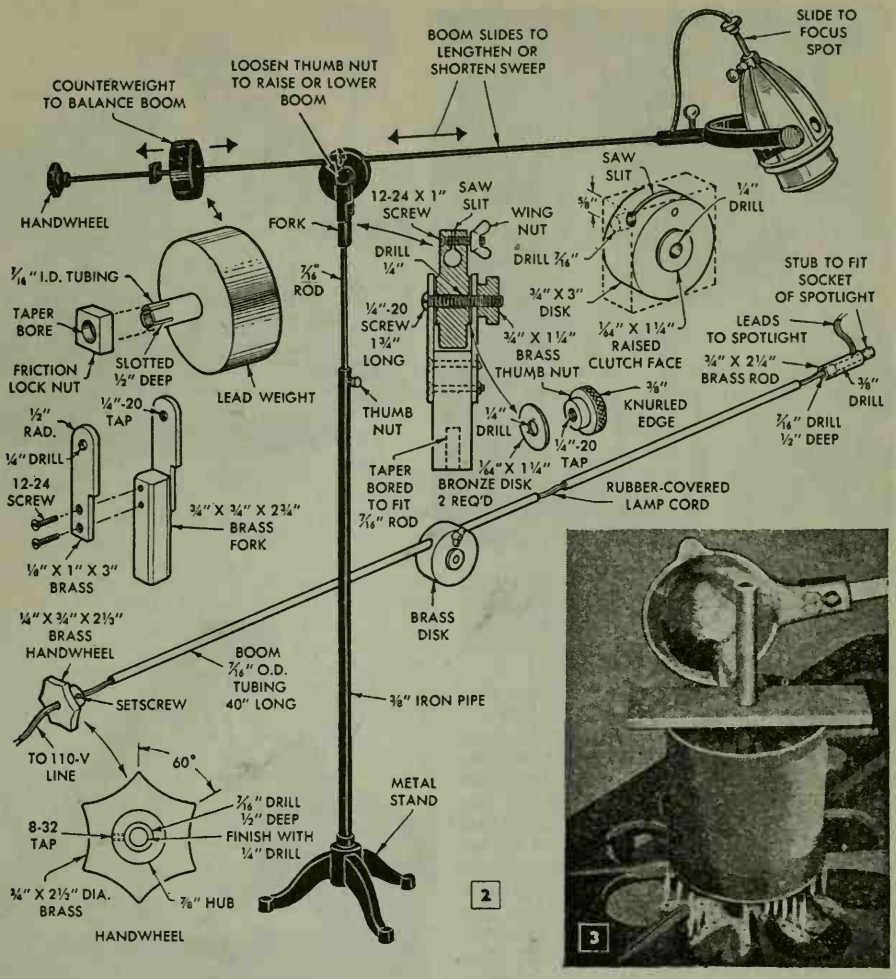


tap the holes as indicated in the center left-hand detail of Fig. 1. The tolerance between the rod and the block should be small so that any vibration transmitted from machinery will not affect the lamp. When selecting a gooseneck fixture for the lamp, be sure to get one that is long enough to provide the range of adjustment that you want. It should be possible to set the lamp near a machine and direct the light almost on the work. A brass pull-chain socket is used because it's easy to reach the chain when turning the light on and off. However, any type of socket that has a built-in switch will serve equally well. No reflector is needed for this lamp since the bulbs that are used have an inside coating that serves this purpose. For ordinary service in the shop, a 200-watt flood or spotlight, as commonly used for photographic work, will fulfill most requirements. For specialized purposes, such as drying paint in a hurry, an infrared bulb is used. And, of course, with an ultraviolet light in the socket, you have a health-giving sun lamp.

The second lamp, the focusing baby spot, Fig. 4, has a smooth, universal manipulation that is obtained by careful workmanship and fitting of each part. It has a large range of adjustment and is especially handy for reaching hard-to-get-at places where the lamp must be set at some distance from the work. Also, the focusing feature makes it possible to cover a wide area or to concentrate the light in one spot, whichever is required. The effectiveness of the lamp is indicated by Figs. 5 and 6. In Fig. 5 the mechanic is outside the beam of

light, which spreads an even illumination over the motor, while in Fig. 6 an ordinary bulb is suspended from the hood, directing its light into the mechanic's eyes as well as on the work.

The spotlight and mounting fork are purchased as an integral unit and, if obtainable, should be made of aluminum because of its light weight. The lighter the holder, the smaller the counterweight and the greater the ease with which the lamp can be manipulated. A heavier stand is needed than that shown in Fig. 1, and the three-legged type illustrated in Fig. 2 is recommended. Construction of the two upright members is similar to that given for the first lamp and they can be made of materials at hand if sufficiently sturdy. The boom is made of 7/16-in. outside dia. tubing instead of rod and is about 40 in. long.

With the exception of the counterweight, the remaining parts, which control the adjustments, can be turned in a lathe. The counterweight is made of lead and should weigh about one third more than the spot. Casting it requires the use of a tin can in which the guide sleeve, 7/16-in. inside dia. tubing, is carefully centered. To prepare the tin can for pouring, bore a press-fit hole in the bottom and steady the sleeve with a wooden brace, Fig. 3. Unless you have a large ladle, it will be necessary to pour the metal in batches. To prevent chilling between pourings, set the can over a low flame but be careful not to melt the bottom. After the lead has set, remove as much of the can as is possible with tin snips; mount the weight in a lathe and true it up. Then shorten and slot the sleeve,

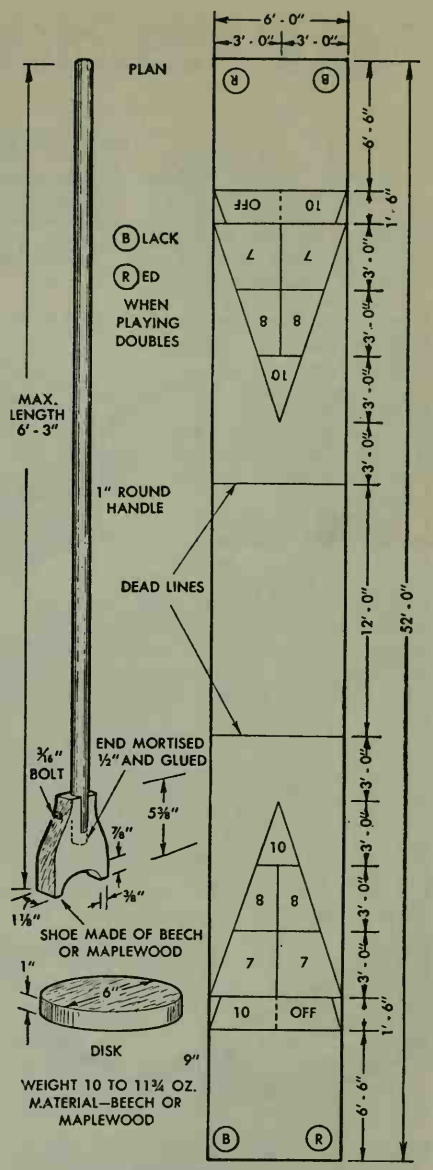
fitting it with a friction lock nut as indicated in the upper left-hand detail, Fig. 2. The fork and disk that serve as the pivoting member for the boom are dimensioned in the upper right-hand and center left-hand details. Construction of the handwheel is shown in the lower left-hand detail. The spotlight may come equipped with a fork that will not fit the boom, and in this case it will be necessary to add a brass-rod bushing, as shown in the lower boom detail. When assembling the unit, run the light cord from the spot through the boom tubing and out the handwheel.

SHUFFLE-BOARD

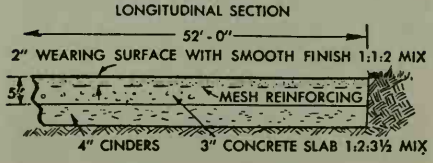
IN MANY localities, shuffleboard has won a wide following. For the home with a concrete drive or with a concrete basement floor, the shuffleboard court can be laid out on the existing concrete. The layout and dimensions are shown in accompanying illustrations, as well as details for making a court and the playing disk.

If a special court is to be built, select a well-drained level site which should be stripped of all sod down to uniformly firm ground. Refill with at least 4 in. of well-tamped cinders. Where the subsoil is firm sand, the cinder fill may not be required. Concrete should be placed in two layers, the base course 3 in. thick of a 1:2:3½ trial mix with not more than 6 gal. of water per sack of cement. This base should be struck off to a grade on which a reinforcement of wire mesh should be placed. The playing course should be laid within 45 min. after the base layer is struck off. This should be 2 in. thick of 1:1:2 trial mix with the maximum size of the coarse aggregate not greater than ½ in. Not more than 5 gal. of water per sack of cement should be used. The concrete should be fairly stiff, requiring some tamping to settle it in place. After the wearing layer is placed it should be brought to a grade with a straightedge, then compacted with a wood float and again tested with a straightedge to detect high and low spots, which should be eliminated if found. Trowel the surface after it has set slightly, and again when it can stand your full weight.

The playing lines can be painted with a high-quality oil or varnish-base paint. Before applying the paint, wash with a solution of zinc sulphate prepared with 3 lbs. of crystals per gallon of water, scrubbing the surface of the concrete thoroughly. After this coating has dried 48 hrs., any crystals on top should be brushed away.



NOTE:—ALL LINES ¾" WIDE
DIMENSIONS CENTER TO CENTER
OF LINES NO EXPANSION JOINTS

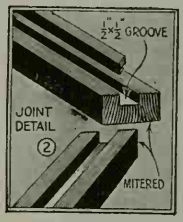


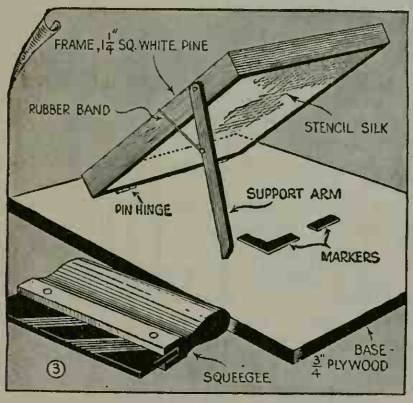
SILK STENCILS

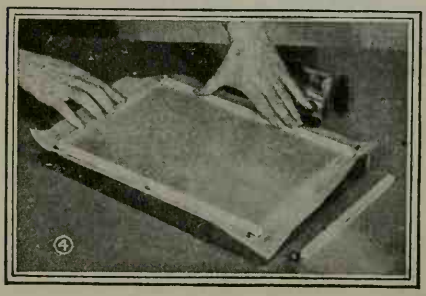
The perfect method for painting greeting cards, cutouts and novelties

SIMPLER than cutting linoleum blocks, silk-screen stencils offer the home craftsman one of the fastest and cleanest methods for painting greeting cards and cutouts. Painting can be done on any flat surface, and the design can be worked on wood, cardboard, cloth, or any other material. Photographic processes simplify the art work, so that intricate designs can be reproduced easily by the average worker.

The setup is simple. As shown in Fig. 3, there is a wooden frame on which is stretched a piece of stencil silk or organdy. The frame is hinged to a baseboard with two pin hinges. The design is painted or blocked out on the silk screen and is reproduced by forcing paint through the open meshes of the screen, using a rubber squeegee. Typical application of the silk-screen stencil can be seen on soft-drink bottles, many of which are lettered by this method. Screened stencils can usually be recognized by a close inspection of the painted surface—the weave of the cloth leaves a faint tracery in much the same manner as a brushed surface shows brush marks.

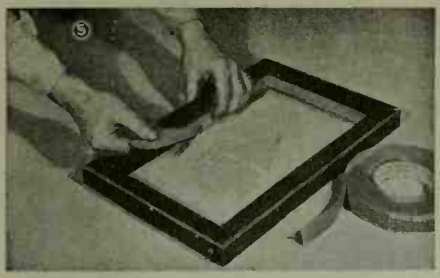






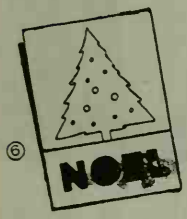
Making the frame: In setting up for any job, the first thing required is the wooden frame. For average-size work, this is made from 1¼-in.-square white pine. The frame should be about 2 in. wider than the design and about 6 in. longer, inside dimensions. Frame members are mitered and grooved, as shown in the detail, Fig. 2. The stencil silk is fitted to the frame by first tacking it loosely in place; then, ½-in.-square cleat sticks are pushed into the grooves, as shown in Fig. 4, stretching the silk drum-tight.

Knife-cut stencils: One of the simplest methods of getting the design onto the screen is the paper mask or knife-cut stencil, as shown in Figs. 5 to 13 inclusive. In the example, Fig. 6 is the copy, which is drawn full size. A sheet of tracing paper large enough to cover the screen is coated with shellac, as shown in Fig. 7. While this is drying, the copy is coated with wax, rubbing on a thin film with the fingers, as shown in Fig. 8. A good wax for this purpose is made from equal parts of beeswax, kerosene and linseed

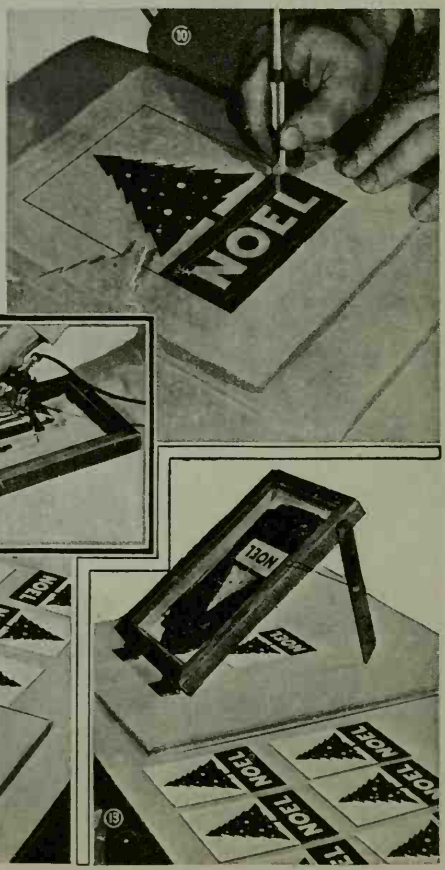


quantity of paint onto the screen, and wipe it across the design with the squeegee, as shown in Fig. 12, forcing paint through the open parts of the screen onto the work surface. Fig. 13 shows the screen in an up position, with the work in place, registered by two cardboard markers fastened to base.

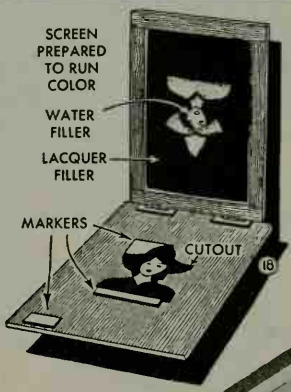
Blockout stencils: Another method of getting the design onto the screen is to block it out with a special lacquer filler. The Dutch-girl cutout for the top of a laundry bag, Fig. 14, is an example. Start, as before, by making a full-size copy of the

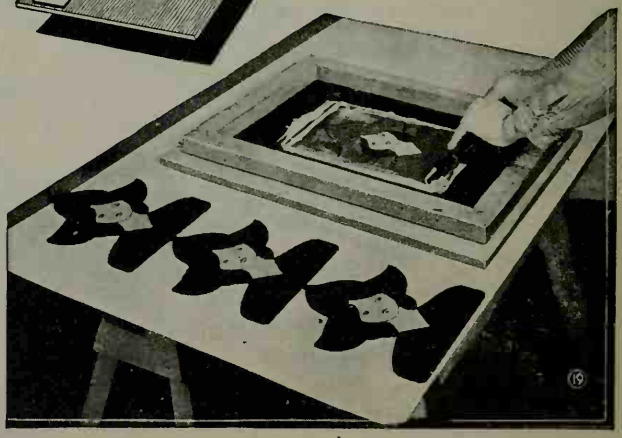


oil. The tracing paper, shellacked side up, is then rolled over the waxed drawing, Fig. 9. All portions of the design which are to print are now cut out with a stencil knife, Fig. 10, the wax coating holding the design firmly in place. Only the shellacked paper is cut, the underneath waxed design sheet being left to hold the design together. After the cutting is complete, the silk screen is placed over the design with shellac side against the cloth and, using a thin, soft, pressing cloth and a medium-hot iron, the design is adhered to the screen, as shown in Fig. 11. The wax paper is then stripped off. Finally, the inside edges of the screen are lined with masking tape, as shown in Fig. 5, to prevent paint from leaking through. The result is a screen completely blocked off except for the design. Then you pour a



design. Transfer the outline of the design to ¼-in. plywood or wallboard and cut out the required number of blanks on the bandsaw or scrollsaw. Stack the cutouts on edge and spray with black paint, as shown in Fig. 15. Then spray or paint the flat surfaces of the cutouts, as in Fig. 16, to make an all-black cutout. The second step is to make the screen, which is done by placing the screen over the copy, as in Fig. 17. The design, which is plainly visible through the silk, is then traced with a medium-hard pencil. Next, the screen is blocked off as needed with the special lacquer filler. Since the cutout is already black, you will not want any of the black in the design to print. Hence, everything that is black on the copy is filled in with lacquer on the screen, also, all the area outside the design is blocked off, as shown by the black in Fig. 18. This design is in two colors, yellow face and red hat and dress. The red is printed first, and, in order to protect the yellow, all the yellow areas are blocked out. This is done with another type of special filler which is soluble in water. In Fig. 18, the gray face portion of the design represents water filler; the black is waterproof lacquer filler. Thus, only the hat and dress are left open, and these areas are painted on the black cutout. After the run in red is complete, the water filler is washed out under running water, leaving the original lacquer-filled screen. The red areas are then blocked off with water filler, leaving the yellow face open for painting, as shown in Fig. 19. It will be apparent that the order of painting can be varied as desired. For example, the cutout could be





(20)

(21)

originally painted all red. Then, since no red is to print, the hat and dress would be blocked off with lacquer filler, leaving the face open for the first run of yellow paint. Then, blocking off the yellow face with water filler, the job would be re-run in black for detail lines. The whole thing is simply a matter of blocking out any area which is not to show in the design, leaving the screen open where you want paint to go through.

Stencil silk: The stencil silk used for brush-filled screens is what is known as No. 16, running about 140 threads per inch. It is available in several grades. Knife-cut stencils of open design can be run on organdy. The paints used should be made especially for screen work. These are available in flat and gloss, also in a special-process lacquer, and are put up in paste form, being thinned as required with a special nonclogging varnish. Average consistency for painting on cardboard or wood should be slightly thinner than soft grease.

Photographic screens: The photographic method requires no artistic ability, since the worker can copy designs directly from any book or magazine with the aid of a camera. In the example, Fig. 21 is the copy. As in any photographic process, a negative is required, that is, the copy must be transferred, in black, to a clear sheet of celluloid or tracing paper. If desired, the negative can be made by hand by placing a sheet of heavy tracing paper over the copy, as shown in Fig. 20, so that the design can be filled in with photographer's opaque or black ink. In the second method of making a negative, the copy can be made with a camera. This gives a negative which has white lines on a black ground. This first negative is then exposed to a second film, which results in a true copy of black lines on a clear ground. Film for this part of the job can be any type of line-process film, such as Kodalith.

So much for the negative. The next job is to sensitize the silk screen so that it can be printed just the same as a photographer prints a photograph. No. 16 stencil silk is used. The sensitizer can be purchased from

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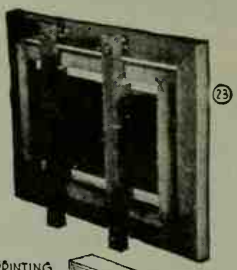

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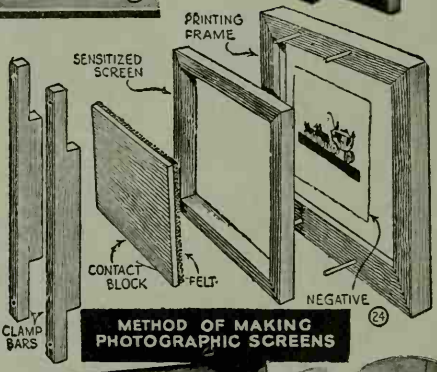
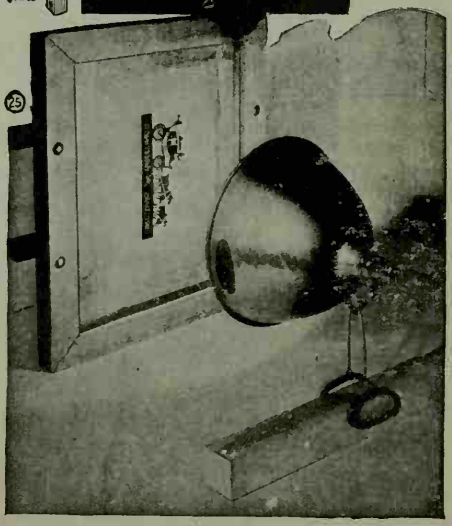


(24)

METHOD OF MAKING PHOTOGRAPHIC SCREENS

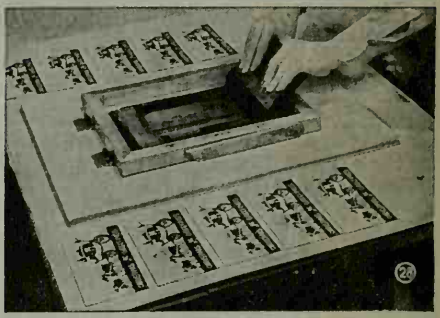


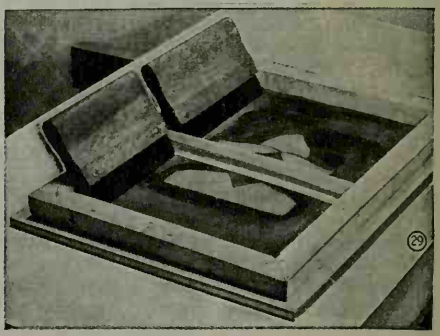
(25)

any silk-screen supply house, and requires only mixing with water to make it ready. The solution is flowed on over the face of the screen, as shown in Fig. 22. All operations can be done in ordinary room light except the drying of the sensitized screen, requiring about 30 min., which should be in a darkened room. After the screen is dry, the print can be made. This is done just the same as printing a photograph, Fig. 24 showing the setup. The negative is placed face up (reading position) on the glass in the printing frame. The silk screen, face down, is then placed over the negative, followed by a contact block and clamps. Fig. 23 shows the frame ready for printing, while Fig. 25 shows the exposure being made, using a photoflood lamp. Exposure time is approximately 15 min., and has the effect of hardening the exposed portions of the screen. After printing, the screen is held under a stream of warm water, Fig. 27, which washes out the soft, protected parts of the design. Fig. 26 shows the finished photographic screen; Fig. 28 shows the job being run. While the example shows printing in one color only, as many colors as desired can be run by blocking out with water filler as previously described. A simple two-color trick is to run the design in, say, red, and then change the position of the screen slightly, about ⅛ in. down and to the left, for the second color (black). The result is the familiar shaded design, which shows as a black silhouette with red edges at top and right side. No change in the original screen is required for this kind of two-color work.

Use of bridges: A useful dodge which can be used to advantage for certain types of two-color work is shown in Fig. 29. The copy is the Dutch girl previously shown, but in this case the hat is to be red and the dress blue. By fastening a cardboard bridge to the screen with masking tape and using two squeegees, both the red and the blue can be run at one time. Another method of multi-color printing is the elimination process. Using the Dutch girl again for an

AFTER PRINTING, THE SCREEN IS HELD UNDER HOT WATER TO BRING OUT THE PICTURE—*LEFT*

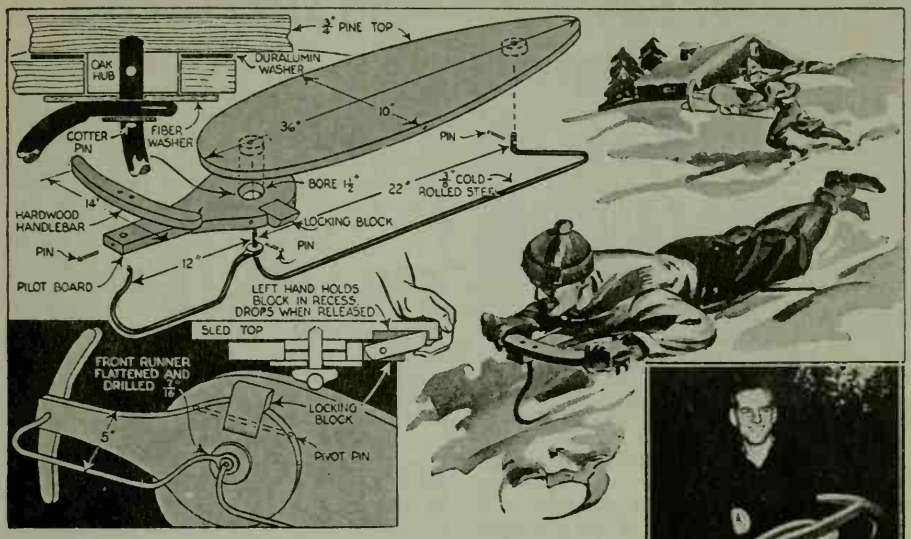




example, the first run would print the hat, face and dress in red. The red hat and dress would then be blocked out, leaving only the face which would be run in yellow. Then, if desired, the face could be blocked out, leaving only the eyes to print in blue. The hiding power of process paints is exceptional, and each new color will cover perfectly over the previous one. Silk screening has many variations. Perhaps the best way to get familiar with this art is to buy a kit with complete instructions and sample designs.

SLEDS

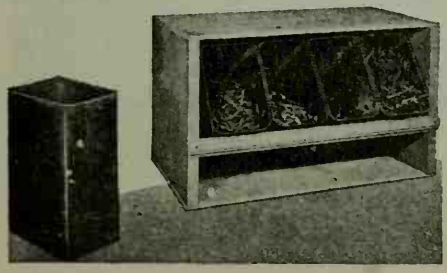
Trim 'Mono Coaster' Has Articulated Runner



Designed for high speeds, this sled with its articulated forward steering runner is easy to maneuver. It steers and balances similar to a bicycle and is equipped with a simple steering-gear lock, which holds the runner straight ahead when the rider wishes to run and flop onto the sled while in motion. The sled is made unusually light without sacrificing strength, and it can be tucked under the arm for carrying. The top is a piece of white pine, oak or other hardwood being used for the pilot board and handlebar. Note that the rear end of the front runner is flattened and drilled to slip over the forward or pivot end of the rear runner. By drilling the hole 1/16 in. oversize, a fair amount of play is permitted to take up some irregularities of the hill.

SMALL PARTS BINS

Empty Varnish Cans and Wooden Box Provide Bins for Small Parts



Rectangular gallon cans, such as those commonly used for varnish, provide ideal storage bins for nails, screws, etc. They will fit compactly into a rack, which can be made, as shown in the photograph, by nailing a divider across the open end of a wooden box to hold the bins at a convenient angle. Remove the tops of the cans with a can opener, clean them and, if desired, give them a coat of paint to prevent rusting. If the edges of the openings are rough, tape them to prevent injuring your hands.

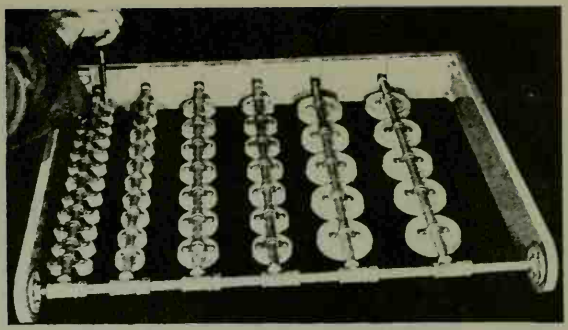
SMALL PARTS DISPENSERS

IN THE COMPACT home workshop where space is limited, a solution to the problem of storing small parts doesn't come easy. Usually the vertical space along the walls must be utilized in a manner that will not interfere with full use of the available floor space. That's where this folding storage rack, or shop dispenser, comes in. The original, built into a wall cabinet, consists of six arms which pivot on a length of pipe. Glass jars having screw-type covers are attached to the arms as in photos at left and on the opposite page. The individual arms swing outward as in the photo below, making it easy to select any item from the glass jars without a lengthy search. Note in the photos on the opposite page how the jar covers are attached to the pipe arms with ordinary pipe or conduit hangers. Reinforcing disks, cut from pressed hardboard are fitted inside each cover, the holes being drilled with the simple jig shown on the opposite page in the center photo. Also note that two small jars are attached side by side in the top row. The method of attaching the covers is shown in the upper photo on the opposite page. Medium-sized medicine bottles of the type having flat plastic covers are ideal for this purpose. As will be seen from the size of the covers on the rack in the upper photo, jars of graduated sizes were used in the original, the smaller ones being placed at the top in a double row.

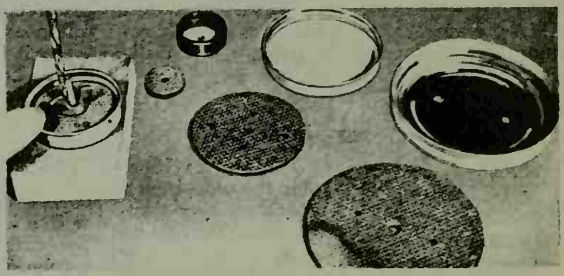
The wall cabinet consists of four pieces of plywood, or solid stock, joined with metal angle brackets as in the blueprint.

Swinging arms make it easy to select any item from this rack. When closed, unit takes minimum of shop space

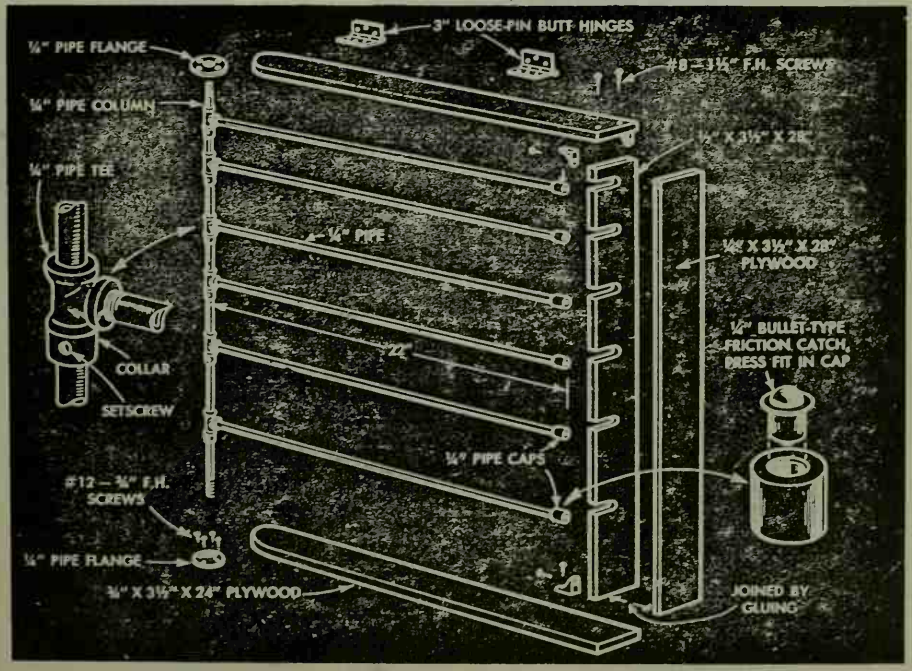
A ¼-in. plywood back is attached with screws. The cabinet is hung with two loose-pin butt hinges so that it may be removed from the wall if necessary. Next a length of ¼-in. pipe is cut to fit between the top and bottom members of the cabinet. The ends are threaded for flanges. Then six lengths are cut from ¼-in. pipe and the ends threaded. One end of each is fitted with a cap and each cap is drilled and fitted with a bullet-type catch as in the detail. Next, six pipe tees are reamed so that they slide over the pipe column and the arms are screwed into the tees. Now, with six collars of a size to fit over the pipe column you're ready to assemble the unit. First, screw a flange onto one end of the column and tighten it, then slide one of the arms over the column and follow with a collar. Proceed in the same manner with the remaining five arms. Note that each collar has a setscrew and can be locked at any point on the column. Screw on the other flange and mount in cabinet.



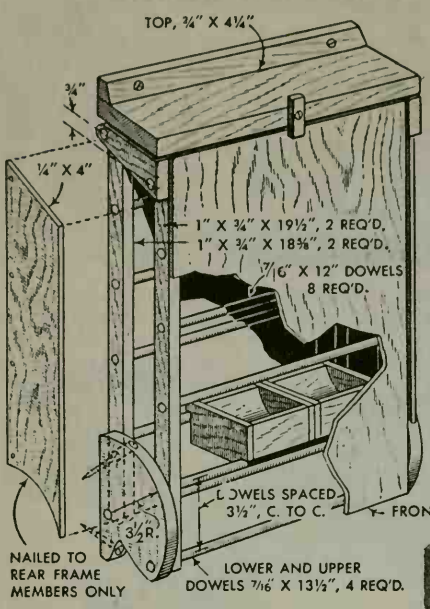
Covers of the glass jars are attached to the pipe arms with pipe hangers. Conduit hangers serve for the smaller jars. Note how free ends of arms enter slots cut in end piece of the hanging cabinet

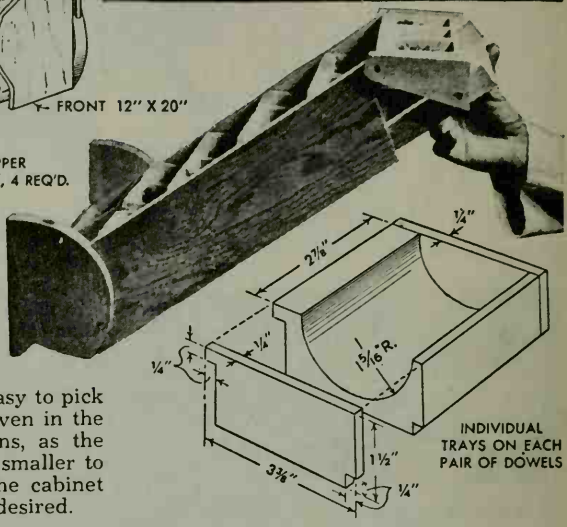


Covers of glass jars are reinforced with disks cut from hard-pressed board. Holes for the stove bolts holding the covers to the hangers are drilled accurately in the simple jig shown at the left in the photo



SMALL PARTS DISPENSERS

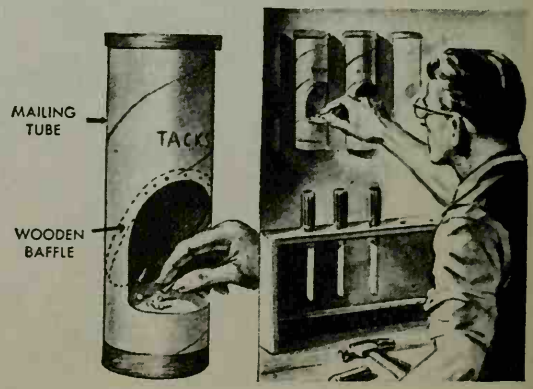




Folding against a wall out of the way when not in use, this cabinet takes little space and has small removable trays that can be taken right to the job at hand. The cabinet is made easily from small scraps of pine, plywood and dowels, and the rounded tray bottoms make it easy to pick out the contents. Dimensions given in the drawings are merely suggestions, as the cabinet may be made larger or smaller to fit available space or needs. The cabinet can be varnished or painted if desired.

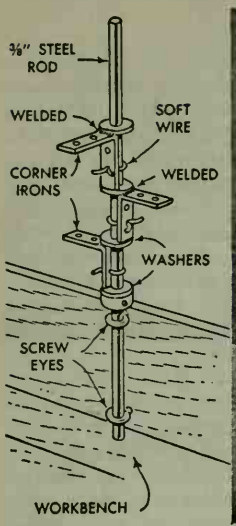
Mailing Tube Holds Small Parts for Easy Dispensing

Fitted at both ends with wooden disks and having an opening cut into the side, a mailing tube makes a good dispenser for nails, tacks, screws and other small hardware. The wooden plugs are turned on the lathe. The bottom plug is permanently mounted to provide a shelf, while the top plug is a loose fit to provide a lid and is flattened slightly to nest snugly against the wall. A wooden baffle is nailed inside the tube, as shown. This baffle has a small semicircular opening at the bottom which permits a small quantity of the hardware to drop down onto the shelf.



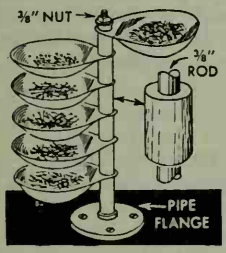
SMALL PARTS RACKS

Swinging Rack of Muffin Pans Keeps Small Parts Handy



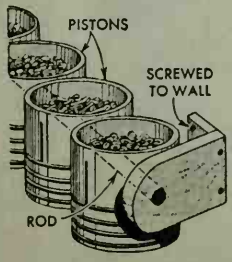
Muffin pans furnish the many separate compartments of a single-post small-parts rack. Mounted on a rod at the back of the workbench, the pans can be swung out of the way when not in use and pulled quickly over the bench for easy selection of a particular part. The rod is inserted through screw eyes turned into the bench back and is held in place by means of a collar. Each muffin pan is bolted to a corner bracket which, in turn, is welded to a washer resting on the corner iron of the tray below. Then, the brackets are fastened to the rod with short lengths of soft wire.

Sectional Rack for Small Parts



This rack is ideal for the workbench because any particular tray can be swung within easy reach while the others are out of the way. The trays are hammered from sheet-metal disks, each one having a lip drilled for the 3/8-in. rod that serves as a standard. Spacers between trays are wooden spools. A pipe flange into which the standard is screwed serves as a base. A 3/8-in. nut locks the assembly at the top.

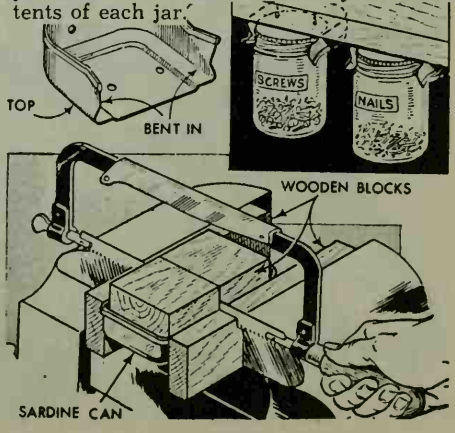
Small-Parts Holders From Pistons



Discarded automobile pistons, pivoted on a length of pipe or rod, make convenient holders for small parts. Wood brackets support the ends of the pipe. To use, tilt the piston so the parts fall into your hand. After it is released, the container will then swing back into the normal position.

Sardine Can Cut to Form Rack For Small-Parts Storage Jars

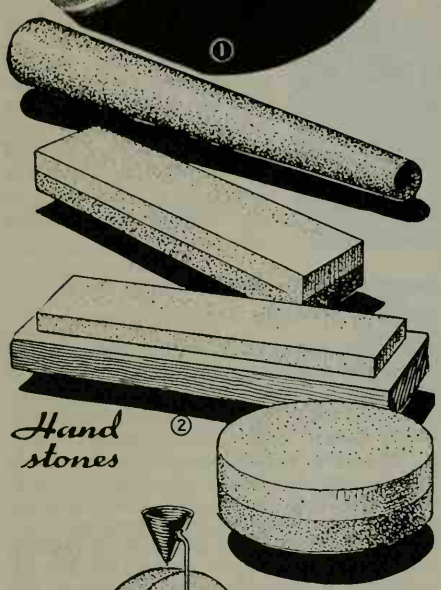
Sardine cans cut in halves and screwed to the underside of a shelf or bench top will serve as racks to hold jars in which screws, nails and other small parts are stored. The can is opened with a rotary opener, and is cut in halves by placing a block of wood in the can and one on either side of it, and clamping in a vise. Using a fine-toothed hacksaw, cut through both the metal and the wood. Then press the sides of the can inward so the bead will engage the jar lid. Lettering on adhesive tape applied to the jar sides can be used to identify the contents of each jar.

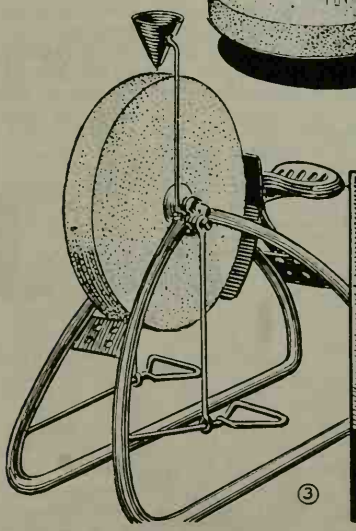


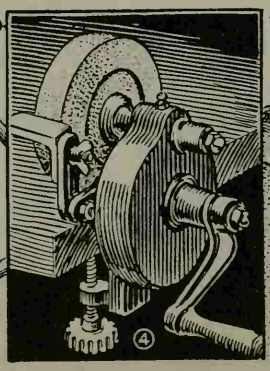
SMALL TOOL SHARPENING

FREEHAND grinding of small tools, holding them against. or moving them over a stone with the fingers without the aid of a clamp, can be done by anyone after a little practice. In this work, you depend largely on the sensitivity of your fingertips. Of course, what you can see is important, but it's really the sense of touch that counts. By it you control pressure on the grinding surface, degree of bevel, straightness of the edge and, on certain tools, the amount of metal removed. Much depends on how the tool is held.

To produce a smooth razor-sharp edge, three or more operations must be delicately coordinated. Sharpening a pocket knife, Fig. 1, is an example. If you hold the knife lightly in one hand and the stone in the other as shown, you can even close your eyes and still know just how much pressure is being applied, whether the blade is riding flat on the grinding surface or at the proper angle, and whether the stroke is taking in the full length of the edge. Some carvers and others who are "fussy" about sharpening a pocket knife, claim that they get a smoother and keener edge by simultaneously imparting a rotary motion to both knife and stone. Woodsmen frequently use the same motions in sharpening an ax with a round stone as in Fig. 23. Fig. 2 shows only four of the almost innumerable sizes and shapes of common hand stones available, the four being those most generally used. In Fig. 3 is a newer type of the old familiar foot-driven grindstone

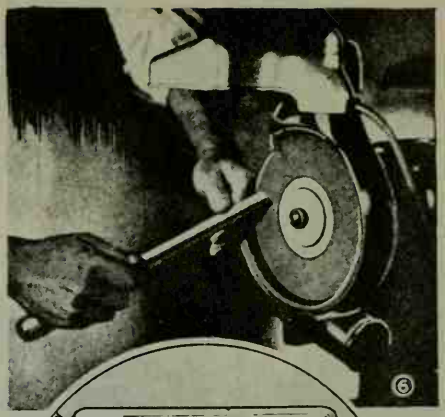






which still has a place in sharpening technique due to slow surface speed and fine cutting properties. Another well known type of hand grinder is shown in Fig. 4, while Fig. 6 pictures an electric grinder with high-speed dual wheels, lights and eye shields.

A common error in hand grinding is applying undue pressure to the tool. This natural tendency must be avoided as too much pressure causes the grinding surface to be clogged with comparatively large particles of metal. Also, the tool heats up rapidly when grinding on high-speed wheels and, in most cases, the finished edge will be unduly "wiry" or ragged. Tool rests on power grinders have a very definite purpose when grinding is done on the face of the wheel, but for light grinding of a variety of small-edge tools skilled craftsmen generally agree that better results are obtained by grinding on the side of the wheel as in Figs. 6, 7 and 8. Reasons for this are that on the side of the wheel the cutting action is slower, the tool has no rigid support, which means that the control is entirely freehand. About the most important advantage in side-of-the-wheel grinding is the ease of holding a true bevel and a square edge. It is unnecessary to move the tool back and forth as must be done when sharpening on the face of the wheel, the flat side of the latter assuring a true edge even on a wide blade as you see from Figs. 7 and 18. Fig. 8 shows the approximate position and angle of the tool with relation to the horizontal centerline of the wheel. Only a close approximation is necessary when grinding common tools.



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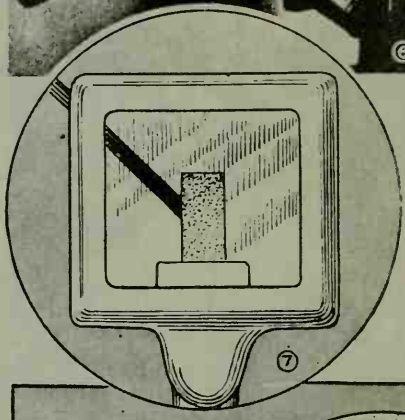

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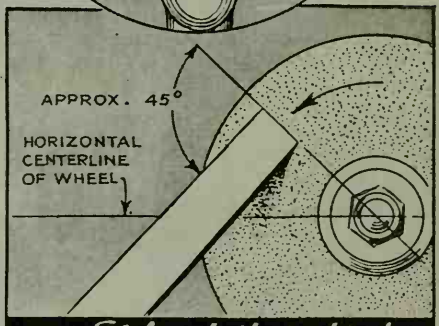
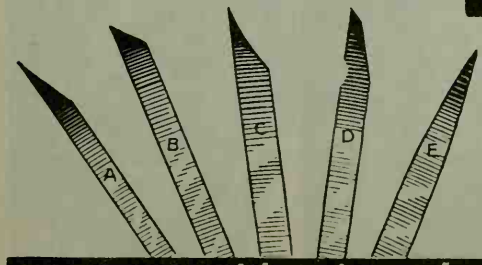
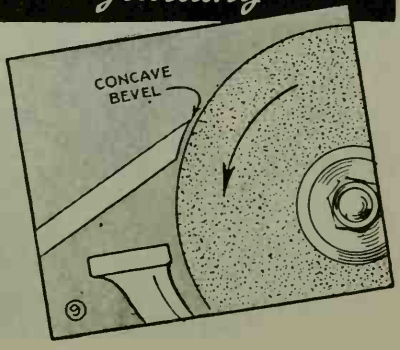


⑧ *Side-of-the-wheel grinding*



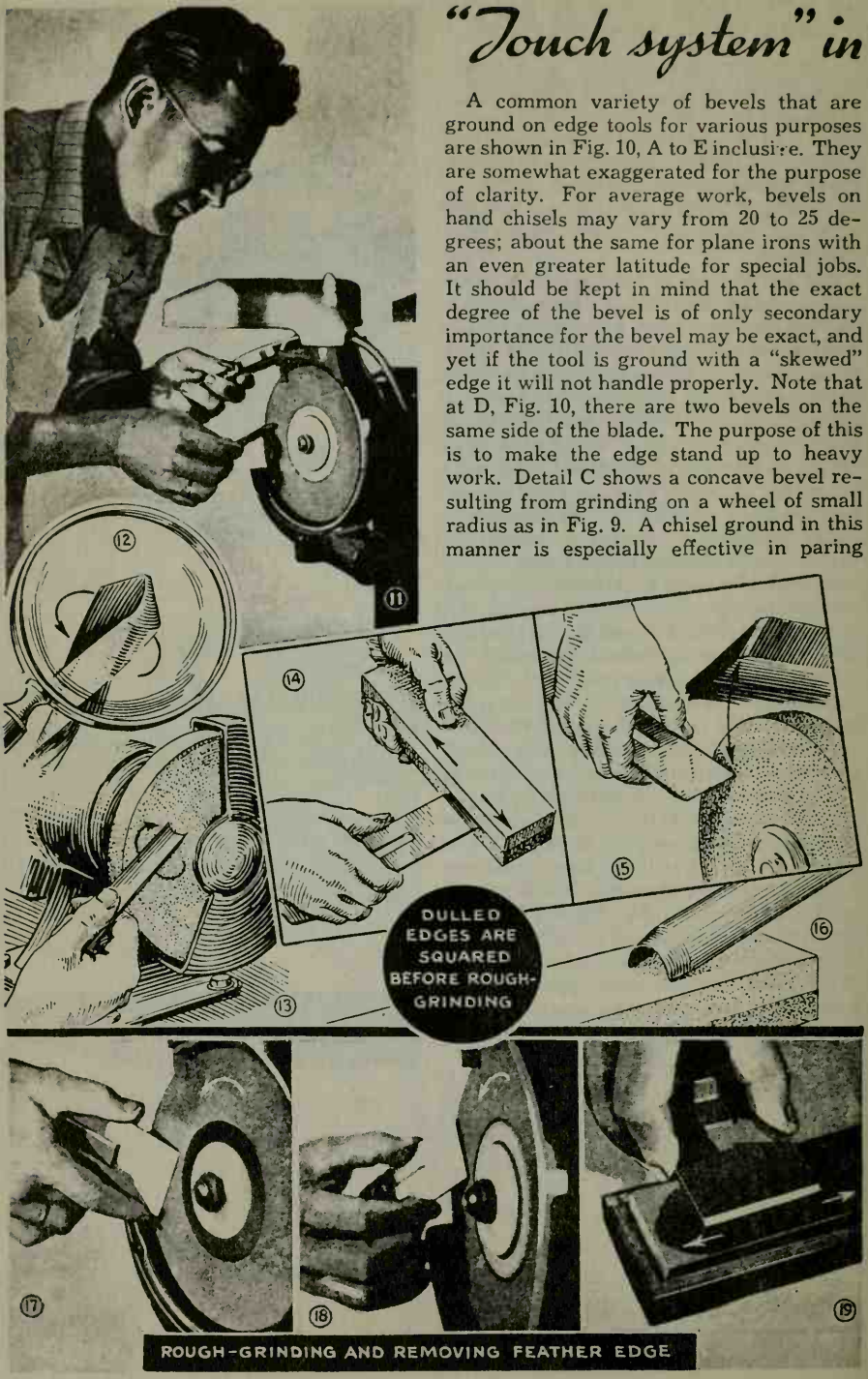
⑩ *Degree of bevel can be changed to suit work*



⑨

"Touch system" in

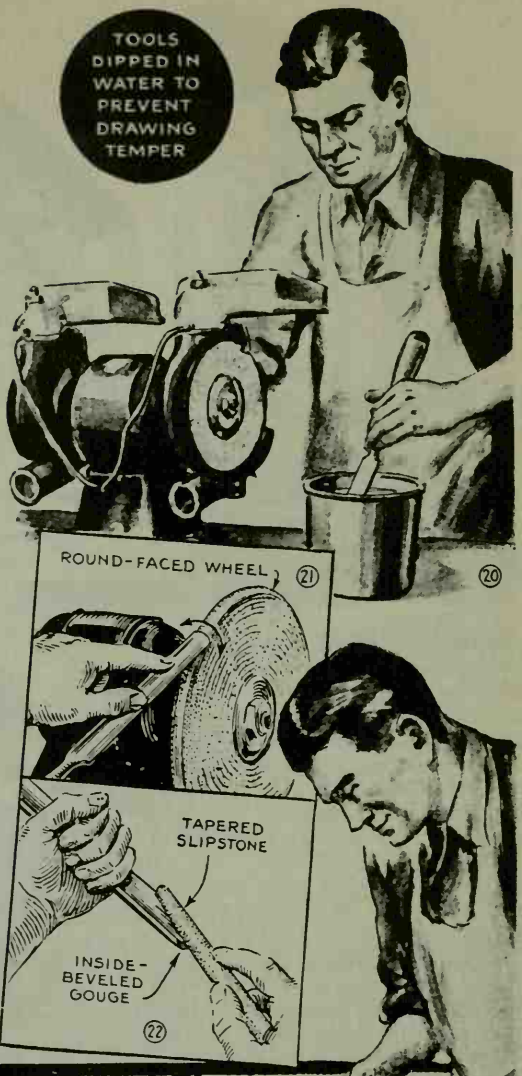
A common variety of bevels that are ground on edge tools for various purposes are shown in Fig. 10, A to E inclusive. They are somewhat exaggerated for the purpose of clarity. For average work, bevels on hand chisels may vary from 20 to 25 degrees; about the same for plane irons with an even greater latitude for special jobs. It should be kept in mind that the exact degree of the bevel is of only secondary importance for the bevel may be exact, and yet if the tool is ground with a "skewed" edge it will not handle properly. Note that at D, Fig. 10, there are two bevels on the same side of the blade. The purpose of this is to make the edge stand up to heavy work. Detail C shows a concave bevel resulting from grinding on a wheel of small radius as in Fig. 9. A chisel ground in this manner is especially effective in paring

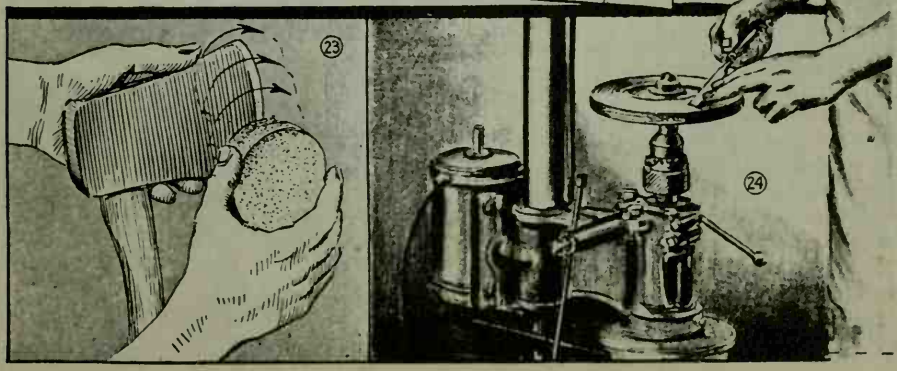


hand grinding

cuts but the edge will not stand prying. "Feathering" of the edge results when you grind with the wheel running away from the tool as in Fig. 5. Sometimes this is necessary, especially on grindstones, but care should be taken to avoid feathering as much as possible.

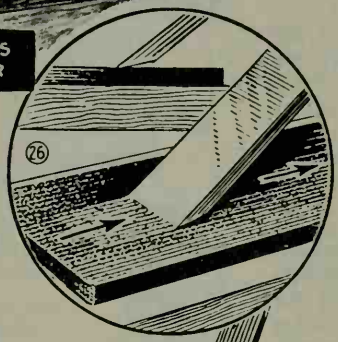
Now for a grinding job that's tricky but entirely practical. Only a few craftsmen and small shops have available a precision grinder attachment for sharpening twist drills. So the job must be done freehand. Take the drill bit between the thumb and index finger, allowing the middle finger and third finger to rest lightly on the body of the drill. Then bring one cutting lip up to the side of the wheel. Now, right here is the first critical point in the whole business. The correct angle depends on touching the lip to the wheel in just the right position. To do this stand so that your sighting eye is directly over the work as in Fig. 11. A reading glass will help by magnifying the point of the drill. As soon as the lip touches the wheel with no light showing, turn the body of the drill slowly to the right, Fig. 12, simultaneously drop your elbow slightly and at the same time pivot your hand to the right at the wrist. That's all. And after you have duplicated these movements in grinding the





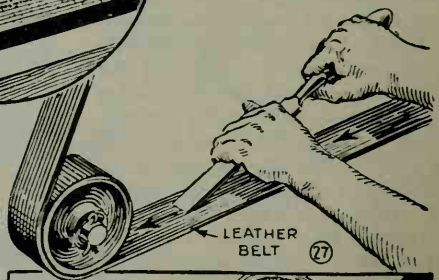
Careful honing

second lip, check with a drill gauge. You'll probably be surprised at the accuracy of the job. If it's a little inaccurate, just a slight touch to the wheel will correct it. Although one can hardly expect to equal the work of the precision jig, a drill bit ground in this fashion will serve very well where the job does not require reamerlike accuracy.



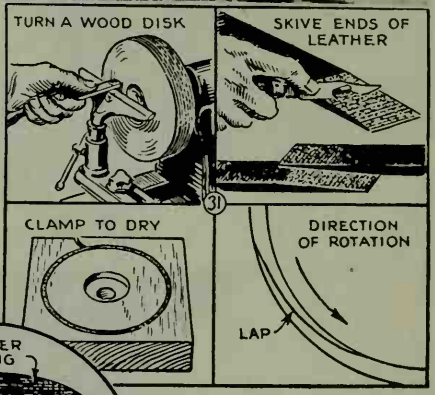
Grinding a gouge, Fig. 13, is done in much the same way as grinding a drill. First, true up the edge as in Fig. 16. Gouges with an inside bevel should be ground on either a round-faced wheel as in Fig. 21 or a tapered slipstone as in Fig. 22. A plane iron requires several steps as in Figs. 14 and 15 and 17 to 19 inclusive, first squaring the edge as in Fig. 14 and then beveling the corners as in Fig. 15. Unless the iron is badly nicked, omit the step shown in Fig. 17, where the nick is removed somewhat more quickly by feathering the edge then removing the feather by grinding against the wheel as in Fig. 18. Fig. 19 is the finish step to remove the wire edge. Some users prefer a slightly rounded cutting edge on a jack plane for rough work. This is formed easily by rocking the blade slightly while grinding on the side of the wheel. When grinding any tool on a wheel don't forget to dip the edge in water frequently to prevent heating, Fig. 20.

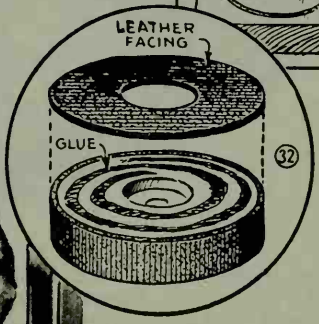
If a floor or bench grinder is not available, Fig. 24 shows how you can rig a drill press for the work. While the picture shows a pedestal-type drill press with the head inverted, the job can be done in almost any drill press simply by gripping the grinding-stone mandrel in the chuck. There will be sufficient clearance on most drill presses so that you can hold practically all hand tools on the rotating stone. A grinding wheel, a flanged adapter to fit ½-in. shafting and a 2-in.



finishes the job

length of the latter are all you need. Finally, most tools used for the finer work should be finished by honing or stropping, either of which can be done in a number of ways. As an example, craftsmen in wood and pattern shops sometimes strop hand tools on a moving leather belt as in Fig. 27, a handy and quick method that does the job nicely. A length of leather belting glued to a wood block, Fig. 25, with the hair side up and coated with polishing rouge rubbed in with the palm as in Fig. 28 does very well. A length of leather belting 2 in. wide, or an old razor strop, Fig. 30, is just the thing for stropping a pocket knife or any similarly bladed tool. Some even strop edge tools on the palm of the hand but most craftsmen who are particular about keen edges on chisels, plane irons and turning tools make a leather-faced honing wheel as in Figs. 31 and 32. To make a honing wheel, first turn a hardwood disk to the desired size, drilling it centrally to slip over the spindle of your grinder or buffing head. Then cover the

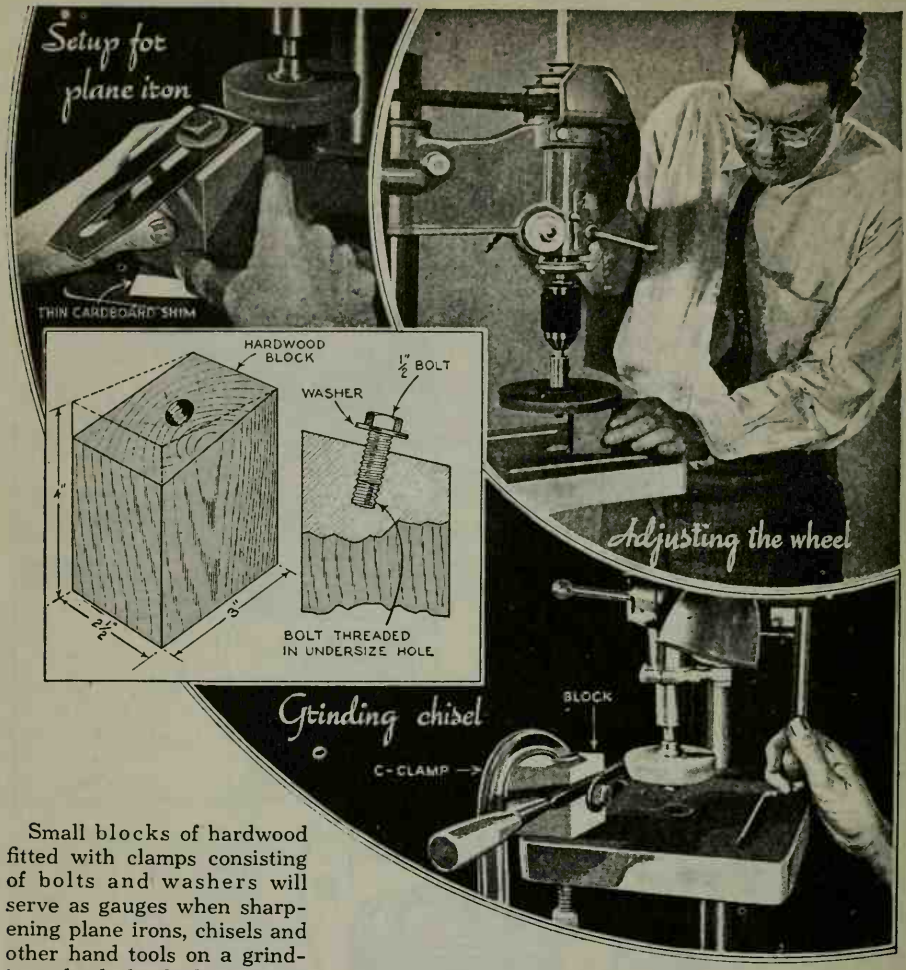




outer edge with a strip of leather, which is skived as indicated in Fig. 31, and glued in place, using a specially made wood clamp to hold it until the glue dries. Next, cut a leather facing, coat one side of the wood disk with glue and clamp the facing to it. Be sure the wheel is balanced carefully to avoid vibration. Such a wheel is most efficient for honing to a smooth edge after grinding and for touching up the edge between grindings. As shown in Fig. 26, the tool should be held with the heel of the bevel raised slightly so that only the extreme edge contacts the leather. In using the wheel, first coat it with polishing rouge as in Fig. 29. Fig. 33 shows how to hold the tools, and the direction of rotation.

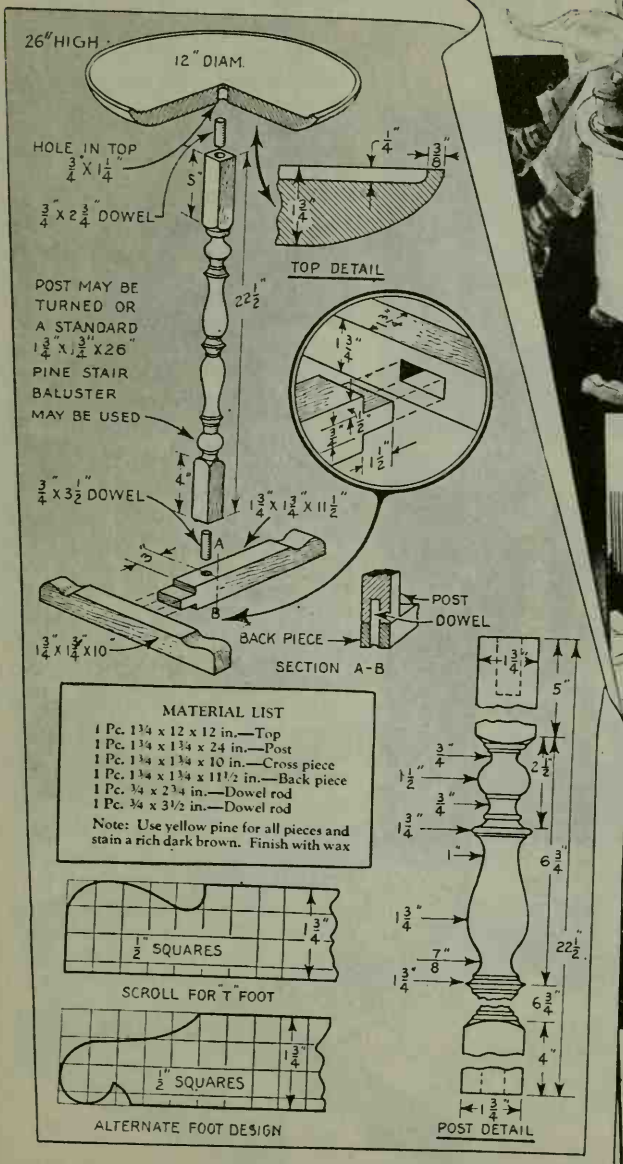
LEATHER-FACED HONING WHEEL GIVES KEEN EDGE

Simple Gauge to Grind Tools on a Drill Press

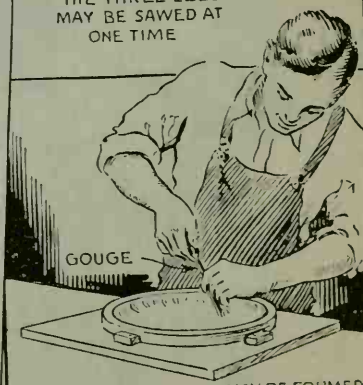


Small blocks of hardwood fitted with clamps consisting of bolts and washers will serve as gauges when sharpening plane irons, chisels and other hand tools on a grinding wheel chucked in a drill press. One end of each block is beveled and drilled to receive a ½-in. bolt, which is threaded into the hole. A large washer under the bolt head provides enough grip for most chisels and plane irons. The bevel will depend on the tool being ground; 20 to 30° for plane irons and 20 to 25° for wood chisels. To use the block, adjust the table and grinding wheel so that the tool makes the proper contact with the edge of the wheel, and hold the block so that if it tips, the tool will not dig into the wheel. Be careful in feeding not to burn the tool. A flat grinding wheel can be used, although a cup type is better. After the first cut, place a sheet of paper under the block to raise it a trifle for the second cut. Repeat this paper shimming as much as necessary. This affords a more accurate control than feeding downward with the drill-press spindle. For hollow-grinding chisels after the bevel has been ground, lay the block on its side, bring the edge against the wheel and feed the spindle up and down.

SMOKING STAND



THE THREE LEGS MAY BE SAWED AT ONE TIME



THE RECESSED TOP MAY BE FORMED WITH A GOUGE AND SANDPAPER

SMOKING STANDS *in*

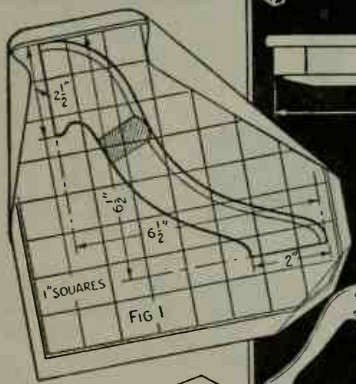


FIG 1

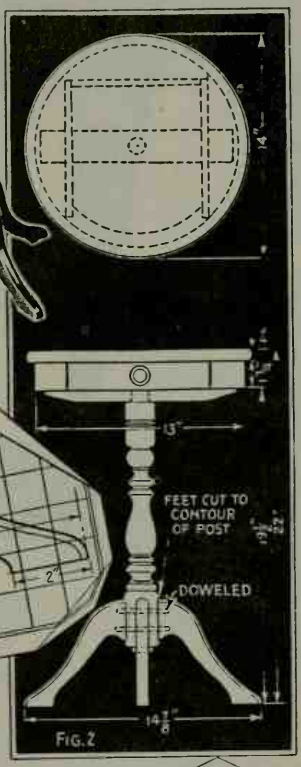
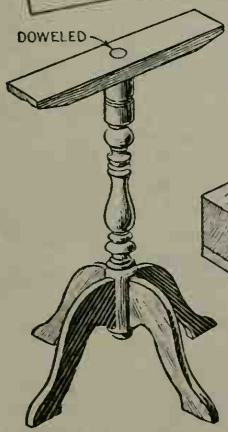


FIG. 2



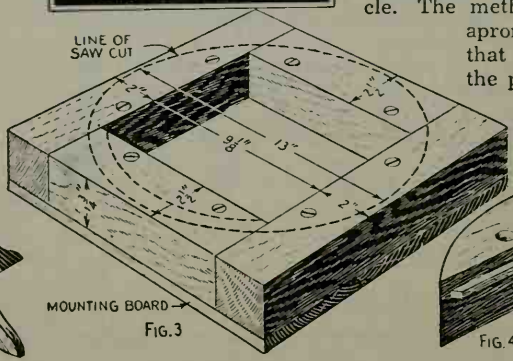


FIG. 3

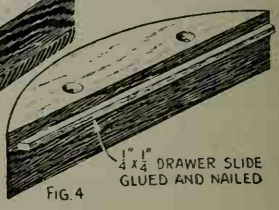


FIG. 4

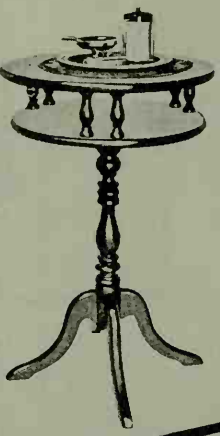
THESE smoking stands are patterned after the ever-popular drum and crow's-nest tables of colonial days. The pedestal is the same for both. The drum type, shown in Fig. 2, is not a veneering job, but is built of solid stock, cut to shape.

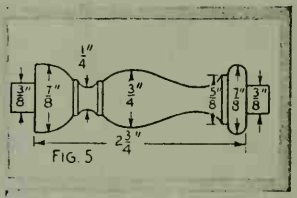
Pieces for the top will probably have to be glued up for width as in Fig. 12, care being taken to match up color and grain. In gluing up the stock be sure to use handscrews to draw the stock against the clamps, to avoid a wind or twist. Disks of this size can be sawed on a band or jigsaw very accurately, by placing an auxiliary wood table over the metal one. A brad driven into the wood table serves as a pivot. The stock is mounted on this pivot and revolved against the saw. The pivot must be placed on a line with the front of the saw and a distance from it equal to the radius of the required circle. A plane and sandpaper are used to round the edges of the top.

The apron for the drum table is sawed from four blocks, as shown in Fig. 3. The four pieces are screwed to a mounting board of scrap wood, taking care that the screws are placed inside the circle. The method of sawing the apron is the same as that used for the top, the pivot being placed ½ in. nearer the saw than before

Colonial Design

because of the smaller diameter. After the apron pieces are sawed they are removed from the scrap wood and planed smooth along the curve, then mounted with glue and screws to the underside of the top piece as in Fig. 9. V-shaped grooves are cut at the joints to give the appearance of a drawer front at both front and back, the real purpose being to hide the joint. The drawer is hung on slides, which are glued and tacked to the side pieces, as in Fig. 4. The construction of the drawer is more or less standard, with the exception of the front, in which it is necessary to rout a groove that holds the bottom. To do this a ¼-in. routing bit is mounted in the drillpress or mortising-machine spindle, and the curved front, guided by strips, is fed past it. Of course, a marking gauge and chisel may be used to accomplish the same results by more laborious means. Details of the drawer construc-





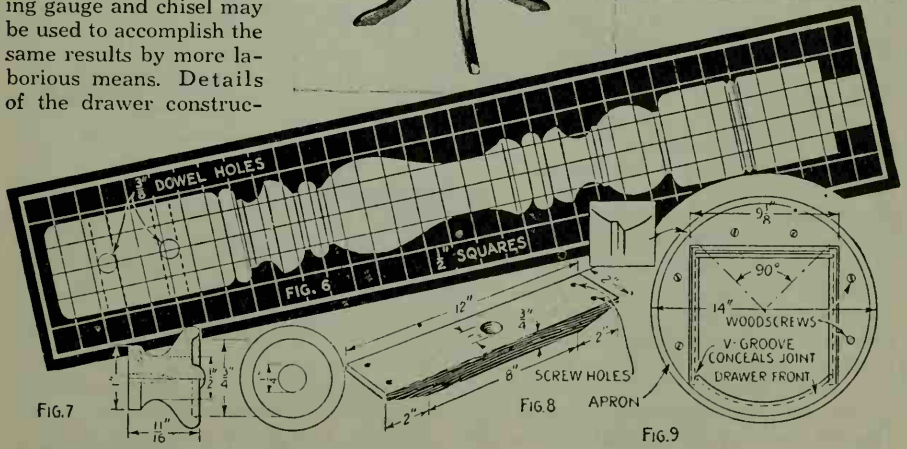


FIG. 7

FIG. 8

FIG. 9

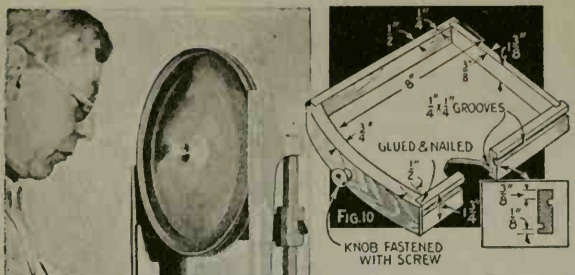


FIG. 10

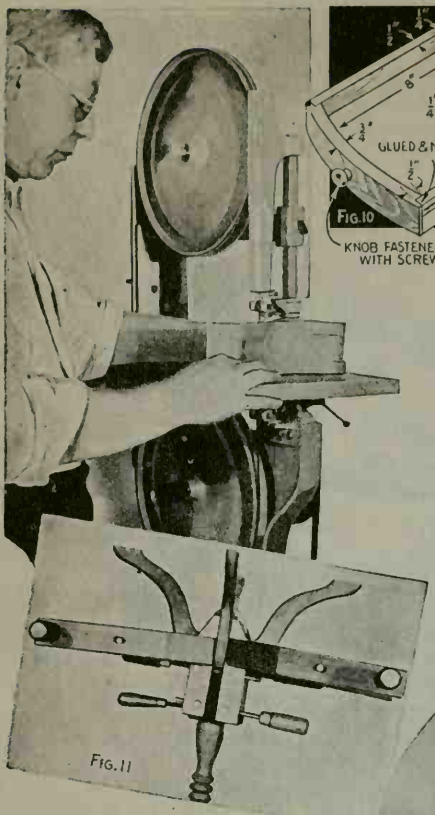


FIG. 11

the glue allowed to set before adding the other two. The method for clamping is shown in Fig. 11.

The crosspiece for the drum table is shown in Fig. 8. It is glued over the dowel on the upper end of the post and screwed to the side pieces forming the apron. The drawer knob is detailed in Fig. 7.. The table is assembled by fitting the drawer into place and fastening the top to the pedestal. Glue a short dowel into a hole in the underside of the top, to prevent the drawer from being pulled out entirely. Be sure you are through working on the drawer,. however, for once installed, the drawer cannot be removed. The pedestal of the crow's-nest table is identical to that described, with the exception that a 4-in. square block is placed on the top of the post instead of the cross brace. The turned tion are given in Fig. 10. The pattern for the feet is given in Fig. 1. Cut out a pattern of stiff paper which can be tacked onto the stock before sawing. Pile up four pieces of ¾-in. stock and brad them together, placing the brads in the waste parts. Then saw the four feet at the same time.

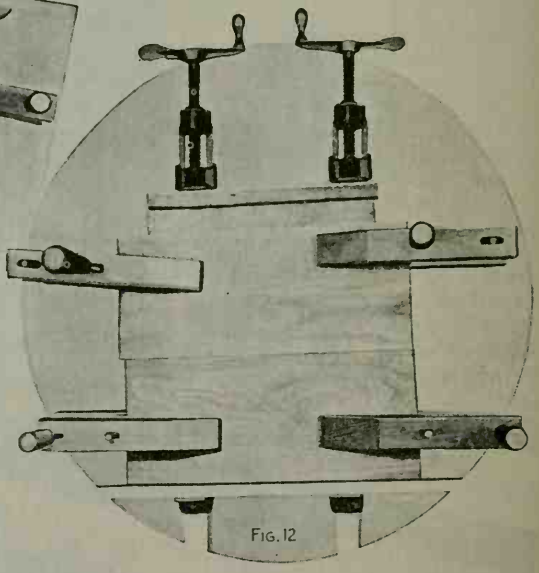


FIG. 12

The turned post is dimensioned in Fig. 6. The feet are doweled to the cylindrical bottom portion of the post, so holes for these dowels should be drilled while the piece is still square. Turn the table in a vertical position and clamp the foot in place. The portion of the foot next to the post must be made to fit the post. After the top edges of the feet have been rounded and the pieces well sanded, they can be glued to the post. Two opposite feet are glued in place first and post should be made shorter also. The upper disk is the same size as for the drum table but the lower one is only 13 in. in diameter. Six turned spindles, the design for which is shown in Fig. 5, are used to separate the two disks. The spindles are arranged in three pairs, 2 in. apart on centers, and spaced 120° on a circle.

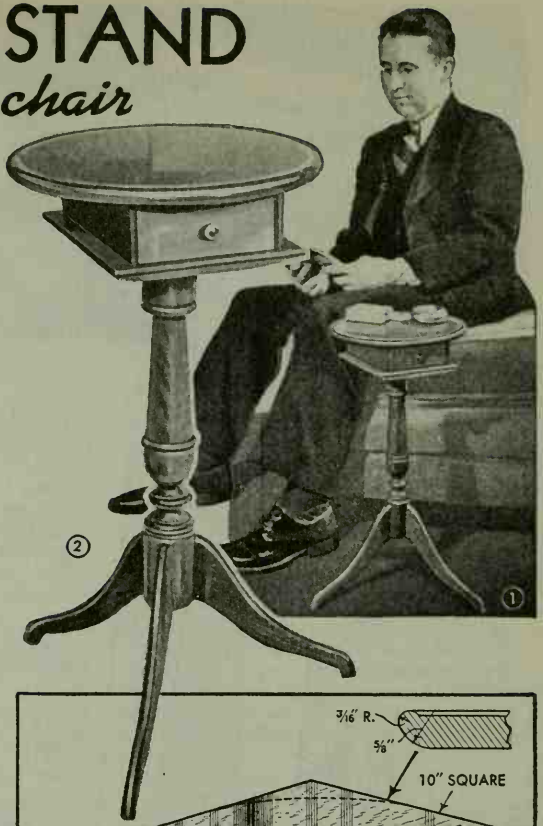
SMOKING STAND

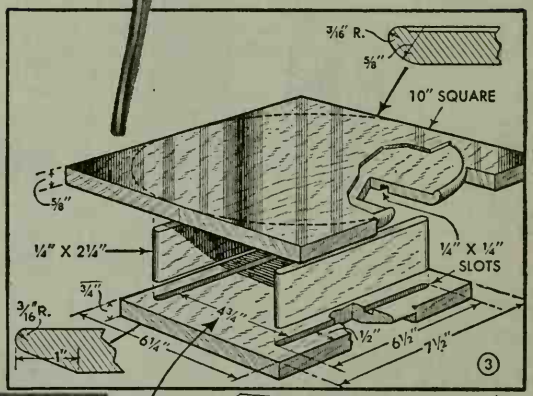
at your easy chair

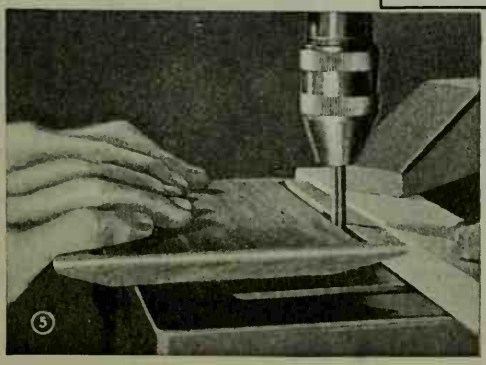
ALTHOUGH designed for smokers, this little table, shown in Figs. 1 and 2, also serves with equal propriety as an end or chairside table. As a smoking stand it is particularly useful, since it has a large drawer to hold accessories. By dividing it into sections as shown in detail B of Fig. 4, various brands of cigarettes as well as matches and other items can be kept neatly separated.

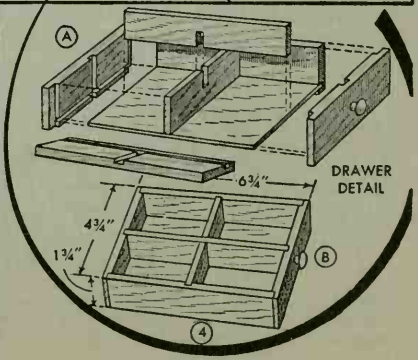
Walnut, oak or any other hardwood is suitable. The top and sub-top first are cut square to facilitate accurate routing of grooves for the sides as shown in Fig. 5. Grooving should be completed before the top is turned to the dimensions given in Fig. 3. Then all necessary turning is done, a hole is drilled through the sub-top for the tenon of the standard shown in Fig. 9, and the edges are beveled as shown in the details of Fig. 3. Round the edges of the side members and sand all surfaces smooth before assembling and gluing.

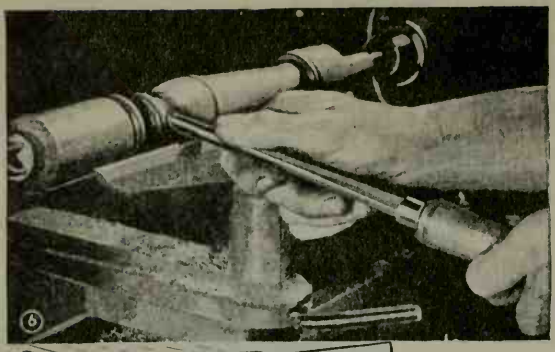
The drawer is constructed as shown in detail A of Fig. 4, all parts being glued and clamped together. Note that knobs are placed at both ends so that the drawer may be pulled from either side. The standard is turned as in Fig. 6 according to the pattern, Fig. 9, three slots being cut equidistant about ¼ in. deep in the lower end





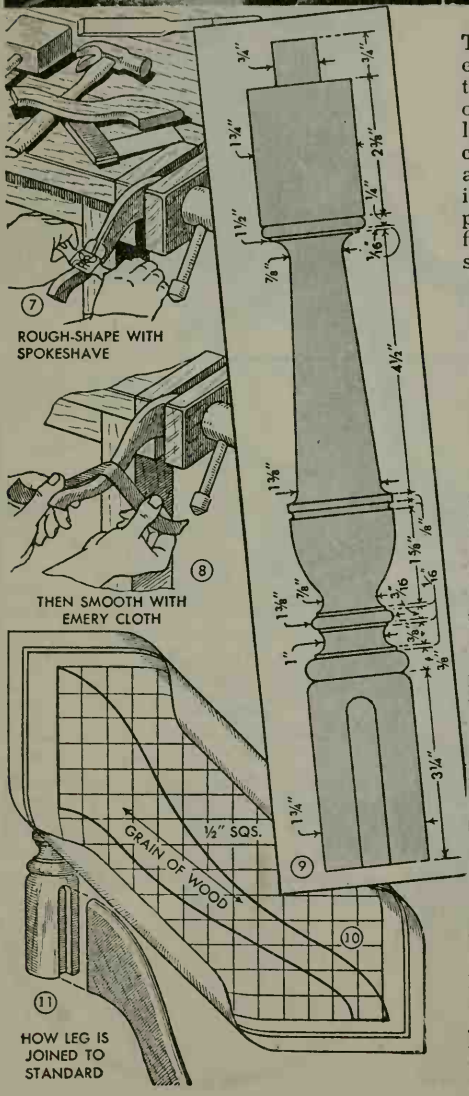






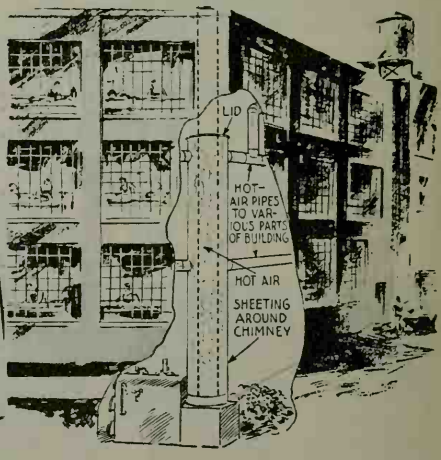
for inserting the legs, Fig. 11 Their design is shown in Fig. 10. The grain should run lengthwise, and the edges are chamfered with a spokeshave, Fig. 7, then rounded and smoothed by using strips of fine emery cloth as in Fig. 8. The standard is glued in place, care being taken to set the top level, and, when dry, the bottom edges of the legs can be trimmed so that the table will stand true.

For finishing, apply a stain and filler combination, allowing it to remain on the wood until the gloss has disappeared. Then, with a piece of burlap, wipe off the excess, rubbing across the grain, and allow the stain to dry for 24 hrs. Two thin coats of lacquer sealer are applied and sanded lightly between coats, after which several coats of clear gloss lacquer are put on and allowed to dry for a day each. If a dull finish is desired the table is rubbed with fine pumice and water, but for a gloss finish, fine pumice and oil, such as paraffin oil, should be used.



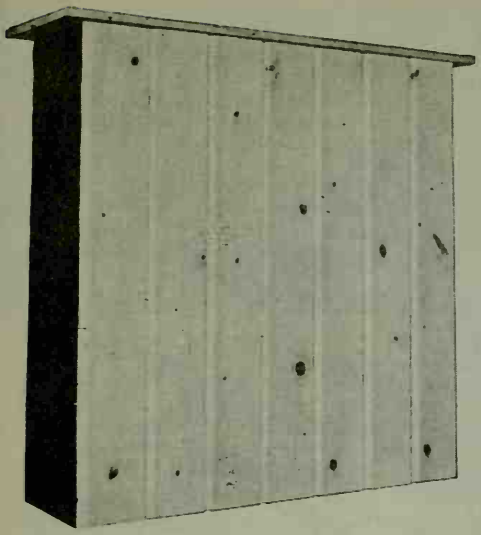
Sleeve Around Large Smokestack Utilizes Waste Heat

In a large factory building, the heat radiated from a steel smokestack was circulated through the building by fitting a

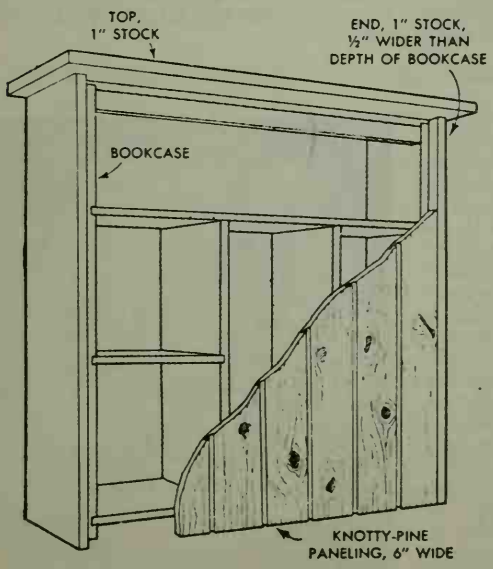


sheet-metal sleeve around the stack. Conductor pipes carried the heat to the desired parts of the building with the aid of a fan. A lid or cap placed over the top of the sleeve could be removed during warm weather to allow the radiated heat to escape in the usual manner.

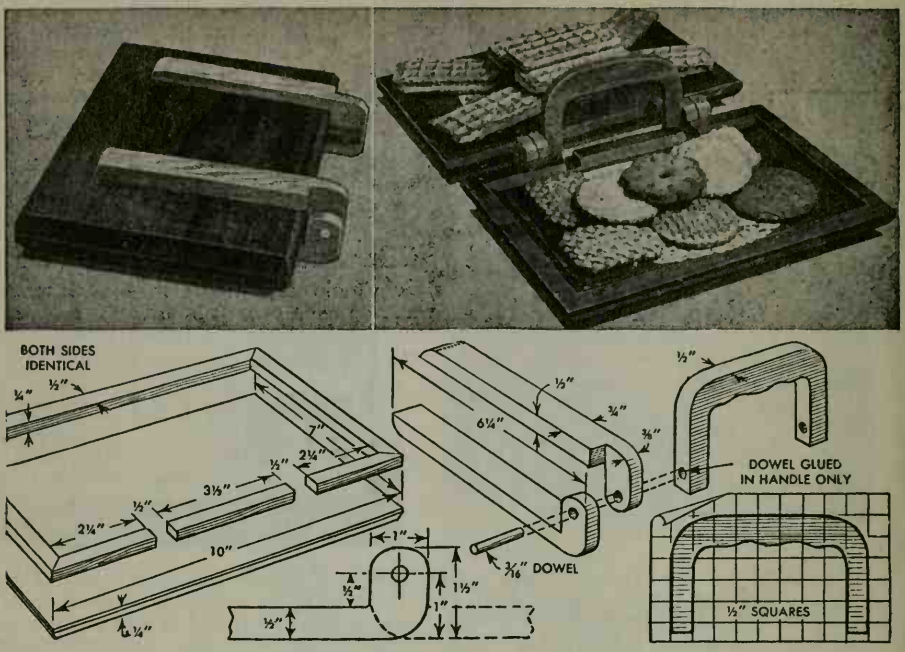
SNACK BAR



SIMPLICITY is the keynote of this snack bar, for half the job is already done by using an open-type bookshelf to provide the interior shelves. All you have to do is face the front of the bookcase with knotty-pine paneling and cover the top and ends with plain 1-in. boards. A 9 x 36 x 36-in. bookshelf was used as the basic structure to make the snack bar pictured above. If you don't happen to have a bookshelf, you'll be ahead by purchasing an inexpensive, unpainted one at a department store. Figure out the number of boards you'll need to cover your particular shelf, picking out select tongue-and-groove material in which the knots are uniformly distributed. The cutaway drawing shown below at left indicates how the end boards are allowed to project at the front to cover the edges of the knotty-pine boards. Use boards of uniform width or at least space them so that the two outside boards are of nearly equal width. The tongue on the starting face board will have to be cut off to make a flush, butt joint with the piece covering the end. Allow the snack-bar top to overhang the ends and the front, and in nailing the top and ends to the bookshelf, use short nails so they do not extend all the way through. Beveled edges on the knotty-pine paneling provide V-joints on the face of the bar to relieve the plain front. The top of the bar may be covered with oilcloth or linoleum and the edges trimmed with regular stainless-steel counter-top edging. A piece of decorative laminate may be cemented to the top for a durable surface. For a natural finish of knotty pine, apply a wash coat of clear shellac, rubbing it when dry with fine steel wool and then follow with wax.



Snack Server Folds Into Small Storage Space

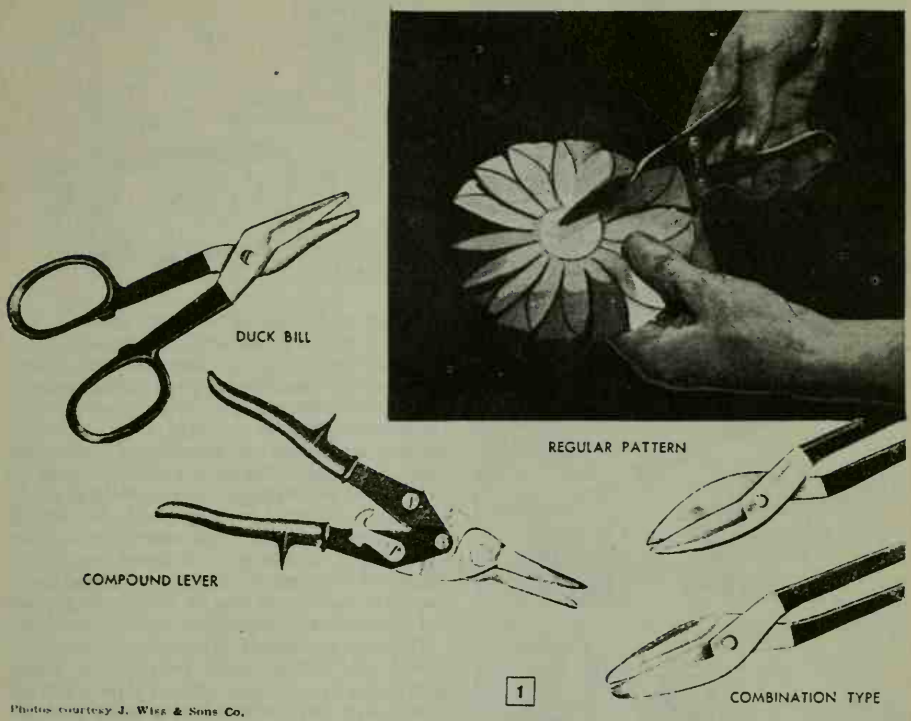


Built of maple and walnut, this snack server folds like a book and does not require the storage space that most trays do. The two halves of the tray are made of walnut which is cut to the dimensions shown on the left side of the detail. Construction of the maple hinges is indicated in the center and the walnut handle is shown at the right. After assembling the hinges and the handle, glue the hinges to the halves of the tray, using casein glue. To finish the server attractively, apply several coats of shellac rubbed with steel wool and then wax.

Wall Protector for Light Switch Provides Snapshot Frame

Unusual frames for snapshots and bill-fold-size portraits can be made inexpensively from plastic wall protectors of the type which fits over standard light-switch plates. The prints may be cemented to the back of the frame around the edges of the opening and the frame merely leaned against another object for support. However, if an easel-type stand for the frame is desired, the print should be cemented to the face of a piece of cardboard which, in turn, is cemented to the back of the frame. The easel is made by cutting a second piece of cardboard, the same width but an inch or so longer than the first. Score it across the width to fold about one third of the way from one end. The smaller section of the cardboard is then pasted to the upper surface of the cardboard photo backing so the lower section will hinge at the score and can be swung outward to support the frame.

SNIPS AND THEIR USE



Photos courtesy J. Wiss & Sons Co.

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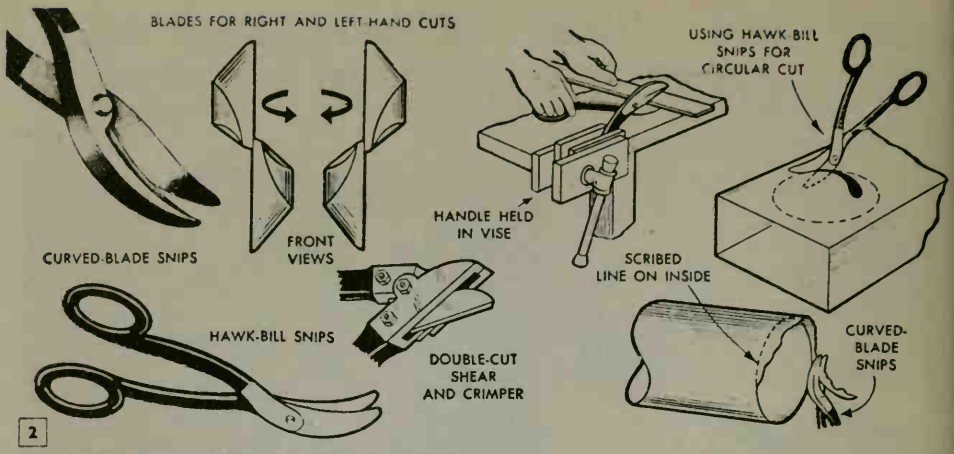
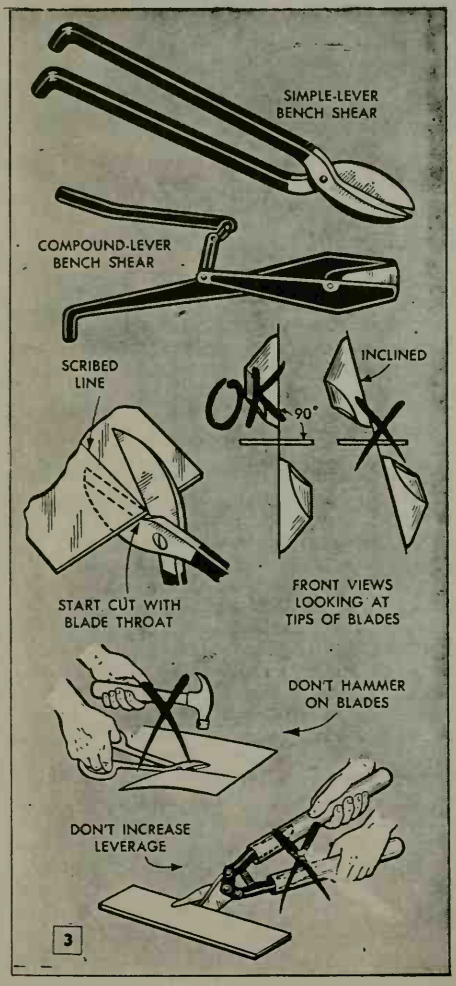
WITH HAND SNIPS of the proper size, you can cut sheet metal having a thickness up to 18 gauge. Snips vary in size from 6 to 17 in. in over-all length, with cutting edges ranging from 1¾ to 3½ in. Both right and left-hand models are available in many types. Some snips are designed for specific purposes, such as the double-cut type and those having curved blades.

Common types: Duck-bill snips, Fig. 1, have narrow, beveled blades with somewhat slender tips that have an outward curve and are designed for making both straight and curved cuts. Compound-lever, or aviation-type, snips also are used for straight and curved cuts. Their special feature is a powerful cutting action that requires minimum effort to operate. By test, one make required about half the cutting effort needed to operate standard 13-in. snips. Most of these have a spring that opens the blades. The blade bevel permits easy handling on curves and the finely serrated cutting edges keep metal from slipping while being cut. The snips come in different patterns, one primarily for straight and limited-curve cuts, one for left-hand and one for right-hand cuts. The 10-in. size is most common. Regular-pattern, straight-blade snips are intended mostly for straight cuts but can be used for large-radius external curves also. The flat inner surfaces of the blades slide along the edges of the stock on straight cuts and should be kept at right angles to the stock surface. Heavy-duty, or "bulldog," straight snips, not shown, have shorter blades and longer handles. Straight, beveled-blade snips, also called combination snips, permit greater side movement than the regular-pattern straight snips when cutting curves.

Special types: Curved-blade snips are especially designed for cutting circles and arcs, Fig. 2. Note the blade arrangement of snips for cutting either toward the left or right. The hawk-bill snips have offset

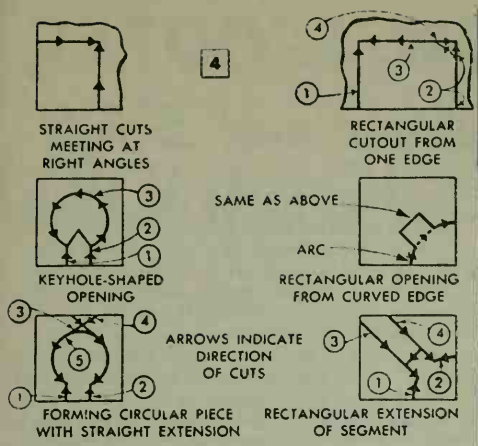




handles and narrow, curved blades for straight or curved cuts in cramped quarters and for cutting openings in ducts. Some compound-lever snips are of similar design. Double-cut shears, which are used to cut off sections of sheet-metal pipe without distorting the metal, are sometimes combined with a crimper. The blade shears on both sides, thus removing a narrow strip of metal. Hand-operated bench shears may be of the simple-lever or the compound-lever type, Fig. 3. The latter cuts sheet iron up to 12-ga. thickness. Both types have bent handles, the lower one to fit a hole in the bench and the upper one to serve as a stop.

How to use snips: When handling sheet metal, it's always best practice to wear gloves for protection against sharp edges. Insert the work about as far as it will go between the blades. Cutting near the throat of the blades is easier and gives better control than cutting near the tips because leverage is increased. Sometimes there's appreciable side spread near the tips, resulting in less-accurate cutting. Hold the snips squarely and start right on the scribed line, as in Fig. 3. Inclining the snips toward one side is apt to pinch the metal between the blades and cause burring. Don't close the blades so tightly that the tips come together in the work, as this bends the metal and is apt to tear it sideways where the tips meet. This also causes sharp edges and slivers. Stop each stroke a safe distance from the tips and start a new one. When you approach the end of a cut that stops in the stock, use the throat end of the blades and cut slowly for best control to stop accurately. Passing the stopping point in metal is a common error.

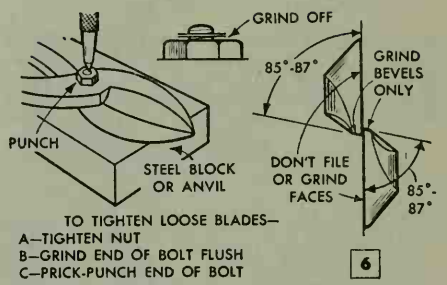
If the cutting edges of the snips drift from the scribed line on the work, hold the snips slightly inclined in the same direction as the drift in order to return to the



line. When cuts in heavy stock become burred, use the throat end of the blades. If this does not stop the burring, cut the stock on the side of the scribed line toward the waste to allow for filing off the burr. When cutting requires excessive effort, the snips may be dull, the blades may be loose or the work may be heavy enough to require the use of larger snips. Don't increase the leverage of snips by slipping pipes over the handles. When cutting large sheets, you can rest the lower handle of the snips on the bench and grip the upper one; this lessens finger strain and allows you to use your weight to advantage. For short cuts in heavy stock you can use snips as in Fig. 2, one handle being held in a vise between pads.

For internal cuts, punch or drill a starting hole in the waste portion near the cutting line. Support the metal on the smooth end grain of a hardwood block when punching. Then use a hawk-bill snips or a similar-shaped compound-lever snips. You also may be able to use a double-cut shears. Handle a hawk-bill snips carefully to prevent springing the slender blades. To trim a straight edge on cylindrical or conical work, scribe a line on the inside surface and cut the edge farthest away from you; for greatest accuracy, use a curved-blade snips as in Fig. 2. You'll avoid considerable trouble if you keep in mind direction and sequence of cuts. Note the examples in Fig. 4. Don't try to make sharp turns in the metal but form inside corners with two meeting cuts. Greater accuracy results from following a thin mark scratched with a sharp scriber rather than a heavy pencil line.

Care of snips: The blades must be kept in firm, sliding contact with each other. If there's space between them they will not cut thin stock, especially near edges, and will burr thicker stock. Also, if blades are



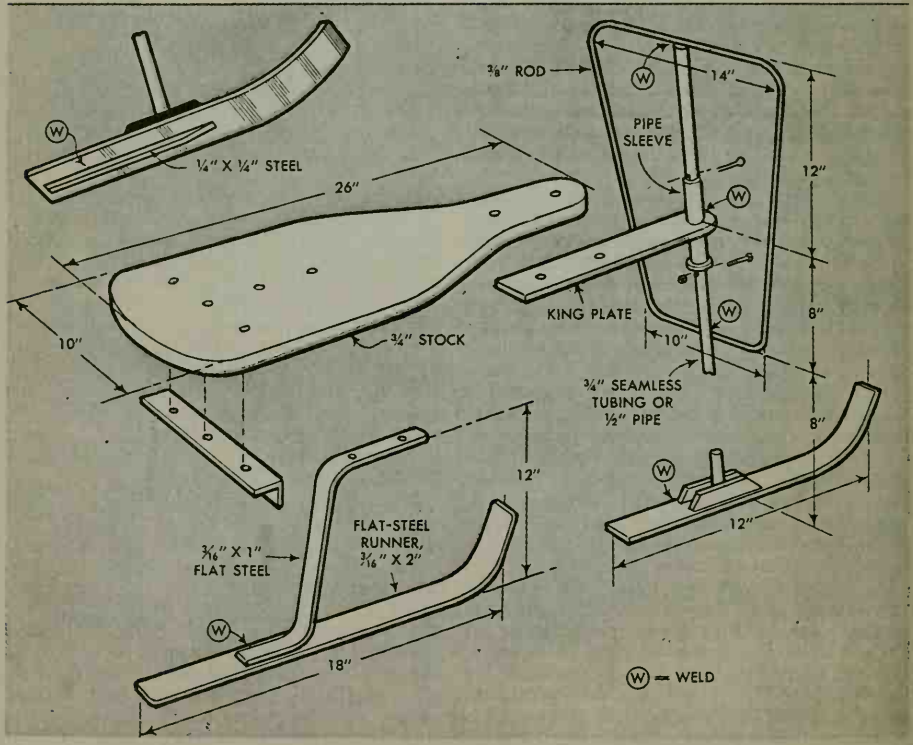
loose, it's hard to follow a line accurately. To tighten blades, turn up the nut on the pivot bolt, file off the projecting end of the bolt and then lock the nut and bolt by prick-punching carefully, Fig. 6. Keep the pivot and blades oiled. When snips are not in daily use, particularly in humid places, protect them from rust by wiping frequently with an oily rag. Keep the blades closed when not in use and hang snips out of the way of other tools. Never nick blades by using snips to cut wire, nails, pins or rivets —use cutting pliers or a bolt cutter suitable for the particular job at hand.

Sharpening: Resharpen dull blades at an angle of 85 to 87 deg., Fig. 6. Use a fine file such as a No. 2 half-round diemaker's file, holding snips in a vise, as pictured in Fig. 5. If you prefer grinding the blades, take them apart. Hold them to the wheel lightly for short durations, and each time the blades are removed from the wheel, dip them in water to prevent drawing the temper. Don't remove metal from the flat face of the blades—only the burr at the edges, using a slipstone or very fine emery stone.

SNOW SCOOTER
is Light and Swift

Rider balances on snow scooter much as he would on a bicycle. Feet on steering bar help to control at high speeds, and steel strip on front runner gives positive-steering action. Homemade original was a favorite among guests at California winter resort

WHETHER you are an adult or a child, you will have great fun and many thrills riding down snowy slopes on this scooter. It requires enough skill to be challenging and yet is simple enough that anyone can use it. The construction is almost entirely a matter of welding and bending. With the exception of the seat, which should be cut from clear, well-seasoned straight-grained wood, all of the material to make the scooter can be picked up in a junk yard at small cost. First, cut the steel for the runners and supports, then bend and weld as shown. Next, put together the steering post and front assembly, noting that the steering bar is bent to shape and welded after the steering post is assembled. Finally, shape the wooden seat and attach it to the front and rear runner assemblies with carriage bolts. Then paint all surfaces except bottoms of runners.

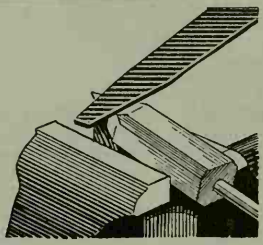


SOLDERING TECHNIQUES

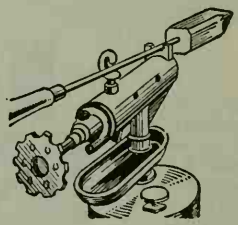
SOLDERING is something like painting—at some time or other nearly everyone finds it necessary or desirable to do the job himself and save both time and money. But in making the average soldered joint the procedure is so simple that there is a tendency to slight some of the details essential to good work. Correctly made, a soldered joint is durable. Take as an example gutter and downspouts, the parts of a building which are exposed to the most severe weathering. If you examine old gutters which have long since eroded to the point where they no longer serve their purpose you will see that in nearly every instance the soldered joints are still sound. The same will be found true of many other kinds of work, parts of which have been joined by soldering.

There are three general requirements for good soldering on average light work. They are, a correctly-tinned iron heated to the proper temperature, the right flux for the job, and a clean surface. Tools required for the ordinary job are a soldering iron or bit, as it is often called, a suitable means of heating the iron or the work quickly and efficiently, a coarse file, sandpaper and a wire brush, a damp cloth and clamps to hold the parts to be joined firmly in place. Of course, if the work is of such a nature that it can be dipped, you will need a ladle of sufficient size. If you use an electrically heated iron exclusively then that disposes of the heating problem.

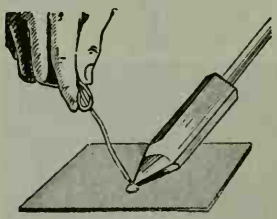
A new iron must be tinned and where the iron is in continuous use frequent retinning is necessary. The chief purpose of tinning is to prevent the formation of copper oxides on the bevels of the tip. Oxides act as an insulator, interfering with rapid heat transfer from the iron to the work. Also an untinned bit won't "take" the solder properly. To tin a new iron or retin one that has been in use, first heat it to a temperature of 500 to 700 deg. F., and clean with a wire brush.



The soldering iron must be cleaned before tinning. Use a coarse file but be careful not to remove more copper than necessary

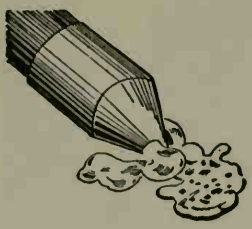


Heat the iron with a blowtorch and watch that it does not get too hot. Always place the iron in the special rack as indicated

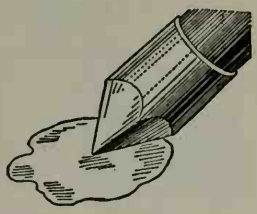


Apply flux to the tip, then coat the four bevels with solder. Build up sufficient solder so that it can be spread out evenly

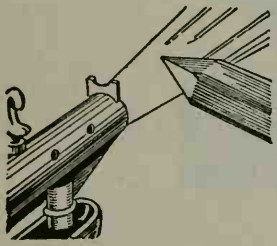
Finally, wipe and twist the tip on a damp cloth to spread patches that remain on the surface. Reheat if necessary



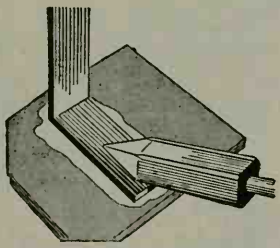
Here's what happens when the iron is too cold. The solder won't flow, but only softens to a waxlike consistency on the surface



But when the iron is heated to just the right temperature the solder flows or "draws" smoothly into joint without piling up



Don't hold the tip of the iron in the blowtorch flame this way. Direct flame will overheat the iron and remove the tinning



Trick of sweat-soldering one small part securely to another is easy if you proceed correctly in the preparation of the work

TABLE I
MELTING POINT OF VARIOUS SOLDER ALLOYS

Tin	Lead	Antimony	Melting Point °F.
0	100	0	618.8
10	90	0	577.4
20	80	0	532.8
30	70	0	491.0
31	69	2	370.4
38	60	2	370.4
40	60	0	446.0
49.25	50	.75	365.0
50	50	0	401.0
60	40	0	368.0
66	34	0	356.0
70	30	0	365.0
80	20	0	388.4
90	10	0	419.0
100	0	0	450.0
0	0	100	1166.

Sometimes it will help to rub the beveled tip on a block of sal ammoniac or ammonium chloride. Usually, however, it is only necessary to apply a rosin flux to the cleaned tip and flow on solder until the entire tip of the iron is covered. Finally, wipe and twist the tip on a damp cloth to spread the solder in a uniform coating.

The purpose of a flux is in most cases twofold—to help clean the work and to prevent the formation of oxides which interfere with the flow of solder. There is no all-purpose flux. Different metals require different fluxes. See Table II. Two commonly used fluxes are those made from rosin and from muriatic acid (hydrochloric acid) which has been "cut" with zinc, forming zinc chloride. Most fluxes are available ready to use in both liquid and paste forms. For light work you use the handy wire solder with acid core. The acid flux is contained in the hollow wire so no separate flux is necessary. Solder is also supplied in solid-wire form without the flux and in convenient bars. It comes in varying proportions of lead and tin, and in lead-tin-antimony and lead-tin-bismuth alloys. These are all commonly known as "soft" solders. A 50-50 solder, 50 percent tin and 50 percent lead, is good for average light work, although these proportions do not give maximum strength. Where the greatest holding power and resistance to bending or flexing is called for, a 60-40 solder, 60 percent tin and 40 percent lead, is generally used. Some alloys contain 67 percent tin and 33 percent lead. On the other hand, for special jobs such as soldering pewter, a solder composed of 1 part lead, 1 part tin and 3 parts bismuth is quite commonly used. The melting point of this alloy is only 240 deg. F. See Table I.

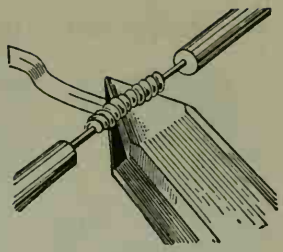
Cleaning of work to be soldered is done with sandpaper or emery cloth, steel wool, files or a wire brush. A power-driven wire wheel speeds up the job of cleaning where the size or shape of the work allows its use. Tinsmiths use reduced solutions of muriatic acid to clean galvanized sheet metal. Hydrochloric acid is an excellent cleaner on some metals, but it is necessary to give the work a thorough washing in a strong solution of soda water immediately after soldering to remove all traces of the acid and stop its corrosive action. Small, irregular-shaped parts, difficult to clean by brushing or by other means, can be dipped in hydrochloric acid. Suspend these on a wire and don't get the acid on your hands or clothing. Avoid breathing the acid fumes at any time. Some metals and certain types of work won't stand the acid bath. Don't use it to clean electrical work.

The requirements of the soldering opera-

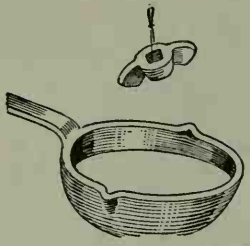
tion are just as simple as actually doing the job. The first of these essentials is that the parts to be soldered shall be heated as nearly as possible to a temperature equal to the melting point of the solder. This assures the strongest bond. On large parts to be joined which contain considerable metal or where the cross sections of the parts are thicker than ordinary, preheating usually is necessary. This ordinarily is done with a blowtorch. Where work must be preheated it is necessary that it be held together with clamps during the heating period, also for a time after soldering until the work cools well below the melting point of the solder. Work soldered in this way should not be subjected to any strain during the cooling period. Where seams, butt joints, corner joints, and curved work are to be joined by soldering, parts must always be carefully fitted beforehand and provision made for holding the assembly in place while soldering. Galvanized sheet-metal parts should always be held together with clamps or by other means. Where you have an intricate assembly requiring soldering several joints in close proximity, use damp or wet cloths to protect the joints already soldered. When using a torch to heat large work preparatory to soldering, heat all the area about the joint but avoid playing the flame directly on the meeting surfaces or on the solder as it is applied. When doing such a job, flux the work first then heat until the flux boils. Apply the solder immediately. When it melts and flows into the joint, withdraw the heat and allow the work to cool to room temperature before removing the clamps or other fasteners that hold the parts together.

Soldering with an iron is much the same as with the torch except that the iron is used to heat the work and melt the solder in a more or less simultaneous operation. A suitable flux is applied to the work which is then heated by applying the iron to the surface. After a preliminary heating, solder is flowed into the joint. On some types of work such as a common butt joint, flowing the solder onto the iron as it moves slowly along the joint will often give the smoothest job. If the temperature is right the molten solder will flow off the iron onto the work in just the right amount.

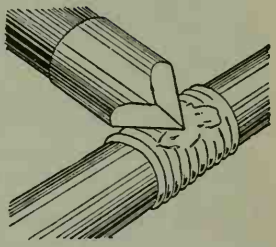
Making a lap joint on two flat surfaces is done by a method known as "sweat-soldering." First the edges are fluxed and tinned. The tinned surfaces are then placed together and heat applied. Where an acid flux is used wash the work immediately with a solution made by dissolving ½ lb. baking soda in a gallon of water. This will remove all remaining traces of acid and stop any corrosive action on the metal.



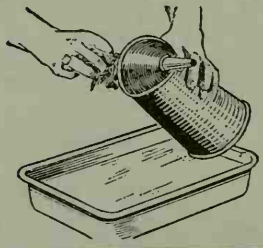
When soldering small parts such as a wire splice, hold the iron under the work. The solder will "draw" into the joint neatly



Small parts can be rustproofed by tinning in a bath of molten solder. Attach a wire to work and hold in solder until heated



To repair a cracked tube, wrap it with wire, closely spaced, then heat and run solder until spaces between wires are filled

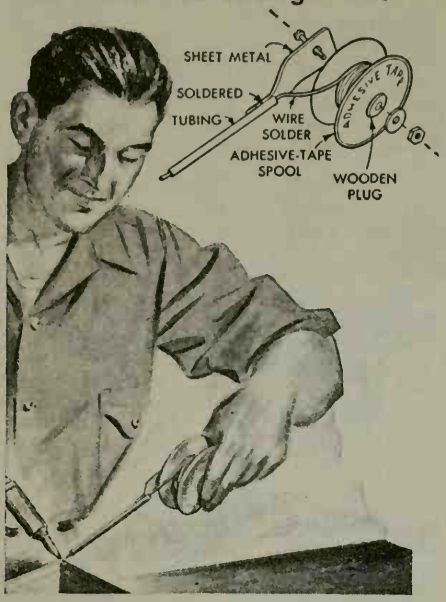


Wash parts to remove the flux. A shallow porcelain-enameled pan is generally the best. Always do a good job of washing

TABLE II
SOLDERING FLUXES USED FOR VARIOUS METALS

Metal	Flux
Iron	Ammonium chloride or zinc chloride
Steel	Ammonium chloride or zinc chloride
Copper	Ammonium chloride or zinc chloride
Brass	Ammonium chloride or zinc chloride
Bronze	Ammonium chloride or zinc chloride
Gun metal	Ammonium chloride or zinc chloride
Nickel	Ammonium chloride or zinc chloride
Lead	Rosin or tallow
Steel (Tinned)	Zinc chloride or rosin
Galvanized steel	Hydrochloric acid
Zinc	Hydrochloric acid
Pewter	Tallow
Silver	Chloride of zinc
Gold	Chloride of zinc
Cast iron	Chloride of zinc with tallow added
Stainless steel	Muriatic acid

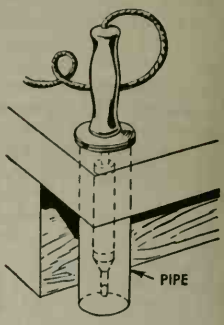
Wire Solder Fed Through Tube



Handy for all kinds of soldering, but especially when working in close quarters or on fine work, this tube-and-spool holder is easy to make and will be a help when you want to do a neat job. Parts required and the method of assembly are given in the detail. Dimensions of the parts are optional and can be made to fit whatever size adhesive-tape spool is on hand. The tube can be of any suitable length.

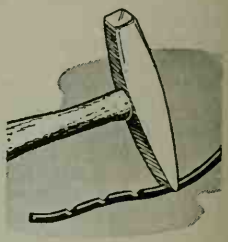
Safe Holder for Soldering Iron

To avoid accidental burns from a soldering iron resting in an exposed holder, place the hot iron in a sheath of pipe or tubing set vertically in the bench top. The tubing is flared at the top for easy insertion of the iron. If the handle of the iron is small enough to slip through the pipe, fit the iron with a large washer or sheet-metal collar below the handle to support it as shown.

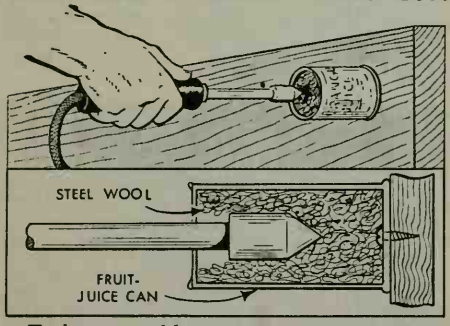


Dents in Solder Dissipate Heat

When using fairly short pieces of coreless wire solder, they ordinarily become too hot to be held comfortably with the fingers. You can prevent this trouble by making dents in the solder about ½ in. apart, using the wedge-shaped head of a riveting hammer. Deeply dented, the depressions in the solder dissipate and slow down the travel of heat.

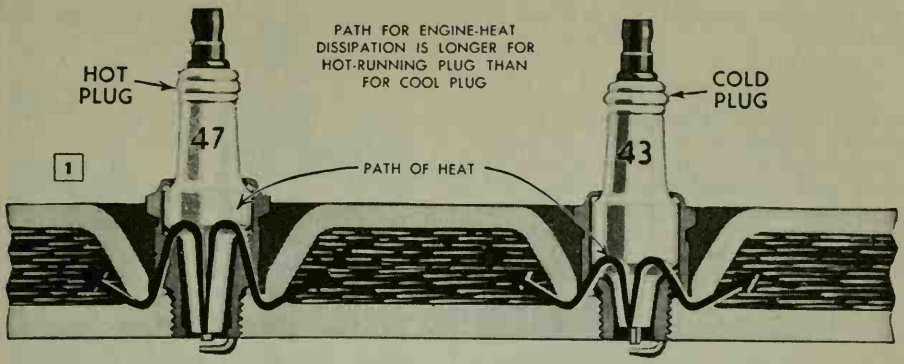


Steel Wool or Cotton Waste Used to Clean Soldering Iron



To keep a soldering iron clean, insert it from time to time in a can containing steel wool, working it back and forth and twisting it around. Use a can of the type in which baby foods or frozen fruit juices are sold and screw it to a wall or part of a workbench. After filling the can with steel wool, bend part of the edge over to keep the wool from being pulled out whenever the iron is withdrawn. It's a good idea to drive several metal screws into the side of the can to prevent the wool from turning with the iron as it is twisted inside the can.

Another handy cleaner for a soldering iron is a floor flange packed with either steel wool or cotton waste. In most cases the flange will be heavy enough to prevent skidding around. However, if more weight is required, the flange can be screwed to a wood block. If soldering is always done in the same place, the flange can be screwed to the bench top within easy reach of the working area.

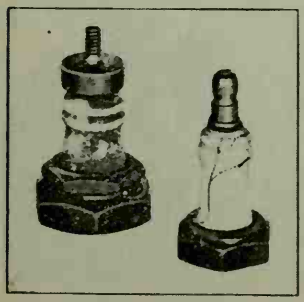


SPARK PLUGS

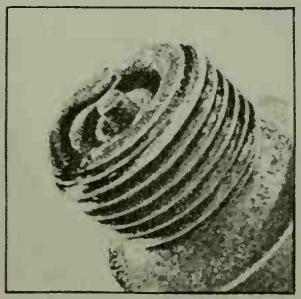
REGULAR servicing procedure applies to the spark plugs, just as it does to all other parts of the car that require periodic attention. Plugs should not be removed, cleaned and adjusted by a haphazard schedule. This may often do more harm than good as frequent removal and reinstallation of plugs is ordinarily unnecessary and causes undue wear on the threads of both the plug and cylinder head. This is especially true when the car is new, unless, of course, faulty engine performance at some time during the first few thousand miles fouls the plugs. In older cars the plugs, and also the ignition system, require a careful check more often to keep these parts performing properly. Badly worn pistons, cylinders and rings accelerate wear on the plugs. On the average, plugs need a careful check every 3000 to 5000 miles, and should be replaced with new ones every 10,000 miles. They will run longer, of course, but with greatly reduced efficiency. At the regular checks of other parts of the car examine each plug to see that the exposed portion is clean and dry, and that the plug wire snaps over the terminal firmly and with a clean connection, Fig. 10. Other parts of the ignition system should be inspected regularly to assure delivery of the normal high-tension current to the plugs.

The basic parts of a plug are shown in the cross-sectional drawing, Fig. 2. Inspection of these parts will tell a lot about how the plug is performing and what to do about correcting any trouble that may develop. The six photos below picture some of the common causes of plug failure.

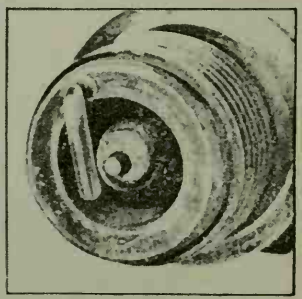
A plug must run hot at low engine temperatures, and cold at high engine temperatures. The running temperature of the plug must be sufficient to burn off ordinary carbon deposits but not so high as to cause detonation, pre-ignition, fusing or blistering of the insulator, or rapid erosion of the points. To obtain the right plug temperature, use a plug of the correct "heat range." This is determined from the type of engine and the operating conditions. When buying a set of plugs, remember there are three "heat range" types—hot, normal



Cracked, dirty insulators affect engine performance, cause compression leaks, shorts, fuel waste

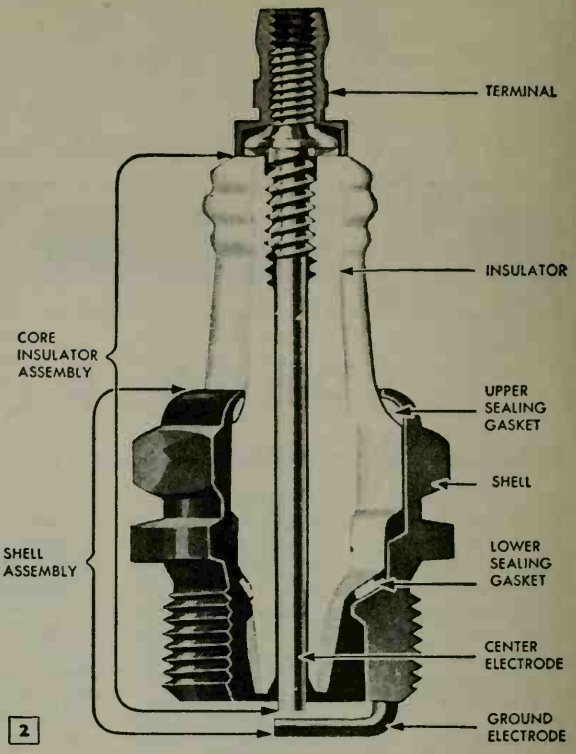


Plug has been running too cool. Shell, electrodes and insulator are fouled with hard carbon deposits



Insulator eroded by oxidation. Tends to short the plug, causing the engine to miss at high speeds

Clean plugs, properly chosen for heat range, give peak engine performance with very substantial savings in fuel and oil consumption and reduce costly repairs



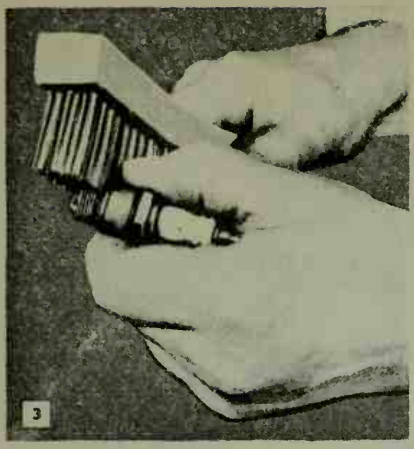
and cold. The hot plugs, Fig. 1, have a long insulator with a correspondingly longer path for the dissipation of heat to the engine block. The insulator on the cold plug is short, heat is dissipated rapidly, and it operates much cooler. A plug operating at the correct temperature will have a soft, powdery deposit on the nose of the insulator —either a grayish tan or rusty brown in color. Wear of the points will be normal and confined to the faces of the spark gap. If point wear is rapid while the color of the insulator is normal, the gap may be incorrectly set or the fault may be in the wrong type of coil. It's well to keep in mind, too, that in old cylinder heads there is the possibility that water passages near the plug may be partially or wholly blocked with hard deposits, causing a hot spot in the head that may affect the plug. Plugs operating too hot will show dark spots or blisters on the insulator nose. The points will be badly burned, in proportion to the length of time the hot condition has existed. Fused and glazed deposits on the insulator may "short" the current and cause misfiring.

Often a plug will be of the correct heat type for a particular engine and still run hot. In this case, the plug may not be tightened sufficiently, permitting hot gases to

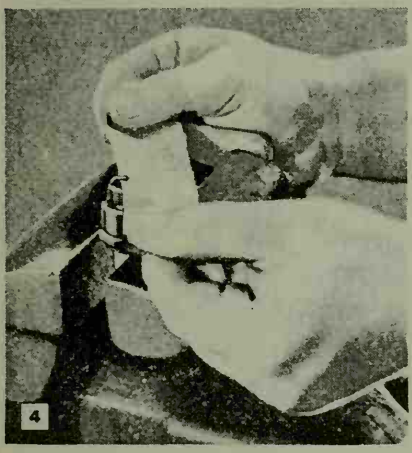
This happens when a plug runs too hot. Undue wear of the electrodes shows in comparatively short time

According to reliable tests, plugs in this condition may waste as much as one gallon of fuel in ten

Insulator broken at the lower end may be due to hot operating conditions or careless installation



Clean the threads of the shell thoroughly. Carbon deposits here will retard dissipation of heat

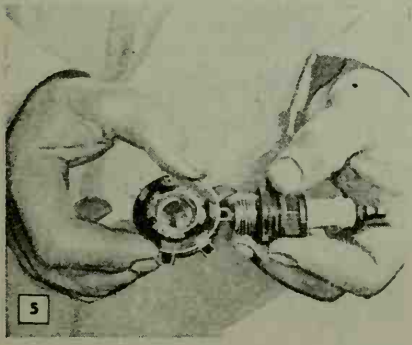


Shallow-pitted electrode points can be restored by the careful use of fine-grit abrasive or a file

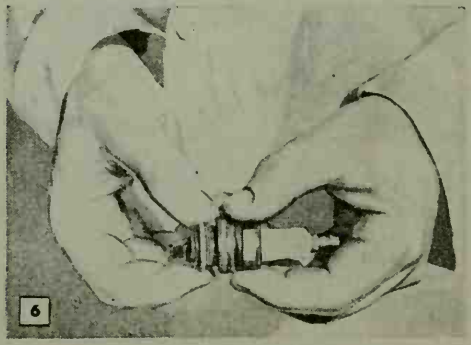
escape and heat the plug in passing out. There may be gas leakage between the insulator and the electrode, or between the insulator and the shell. This condition can be detected by soot streaks on the outside portion of the insulator. A lean fuel mixture, wrong ignition timing, poorly seating valves and other faulty engine conditions, can cause plug overheating. Plugs running too cold will be sooty, gummy and possibly oily. Oil pumping from the crankcase, too rich a fuel mixture and long idling periods will cause this condition. Fuel fouling is indicated by a dull, black, fluffy deposit; oil fouling, by a shiny, black, hard deposit. In judging plugs for heat range, be sure normal operating conditions have existed for a time before making the inspection. Otherwise, one may get a false interpretation of the average plug needs of the engine.

Although servicing a spark plug looks simple enough, there is danger of permanent damage to the plug unless certain precautions are carefully followed. Use a socket wrench of the correct size to remove the plug—never use an end wrench or other makeshift wrench that is likely to burr the plug nut or slip off and break the insulator. Blow dirt out of the plug well before removing the plug to prevent it from falling into the cylinder. Condition of the gasket is important. Inspect it carefully each time the plug is removed. It may be the key to plug trouble or poor engine performance. If the gasket is flattened or badly scored, it may be the cause of a baffling compression leak as well as a hot plug. On the other hand, if the gasket is still rounded, it is probable that the plug has never been correctly tightened. This condition may also be the cause of a hot plug or a compression leak. If there are indications of soot and burning on the gasket, it was not tight enough to seal. The gasket serves the dual purpose of sealing engine compression and acting as a bridge for the dissipation of heat.

After removing and inspecting the plug and gasket, clean the shell threads, insulator and



Use a round gauge to check the gap. Adjust to exact distance recommended by the manufacturer



Before replacing a plug, turn a new gasket over the threads by hand. Make sure gasket is properly seated

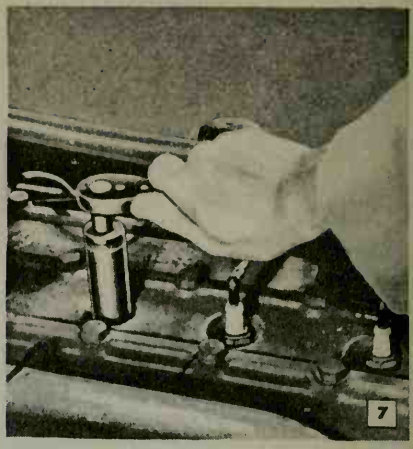
points carefully as in Figs. 3 and 4. Or if desired, take the plugs to a service station equipped with a spark-plug cleaning machine. If the insulator is badly fused, cracked or blistered, the plug should be replaced. Plugs with badly corroded and worn points also should be replaced. Adjust points to the correct spacing by bending the side electrode, never the center one. Use a round gauge, Fig. 5, to check the gap setting recommended by the car manufacturer.

When installing the plug, always use a new gasket and turn it over the shell threads as in Fig. 6. Before screwing the plug into the cylinder head clean the gasket seat with a cloth as in Fig. 8. Turn the plug in by hand, making sure the thread is not crossed and the gasket is not cocked at an angle. Snug it up by hand also, then tighten with a socket wrench only one half to three quarters of a turn, Fig. 7. Wipe the insulator as in Fig. 9 and be sure to connect the correct wire to each terminal.

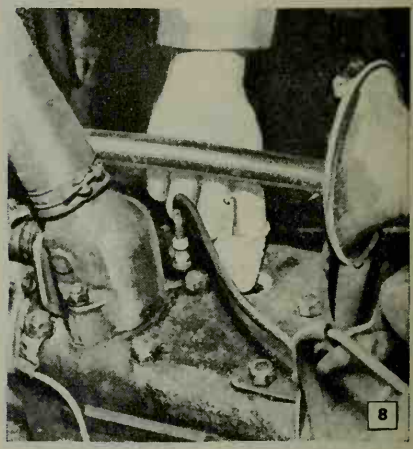
If plugs foul in a new engine, check for wrong lubricating oil in the gasoline for run-in purposes; carburetor adjustment out; improper choke adjustment; car driven too slowly during break-in period; distributor points incorrectly set; coil or condenser weak; plug gap set too close. If the engine misses at high speeds or under a heavy load, check these common causes: distributor points dirty, glazed or incorrectly set; weak coil or condenser; carburetion incorrect; valve-tappets out of adjustment; plug gap set too wide; overheated plugs, calling for cooler plug in the heat range, overheated plugs due to gasket leakage or other causes.

If the engine "rolls" when idling, check the carburetor adjustment; distributor points; coil; engine compression; valve-tappets; improper valve timing; sticking valves and the plug gap. When making any inspection with the plug removed, always check the gap.

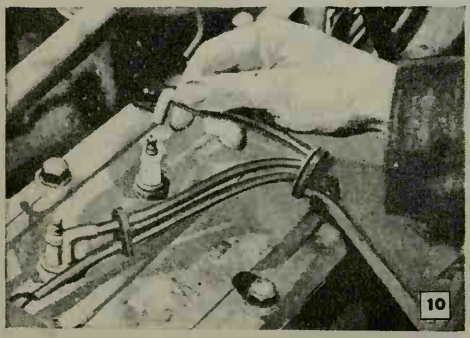
Certain photos and details by courtesy of A.C. Spark Plug Div., General Motors Corporation; Champion Spark Plug Co., and The Electric Auto-Lite Co.



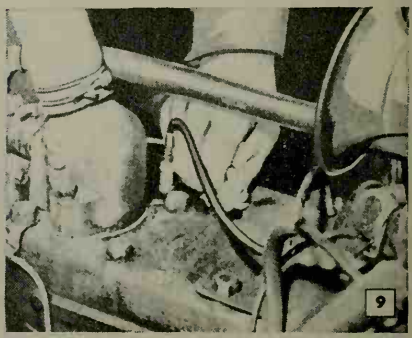
When removing or tightening plugs, use a socket wrench. Other wrenches may burr the hex section



Wipe the gasket seat with a clean cloth before installing plug. Avoid pushing dirt into opening

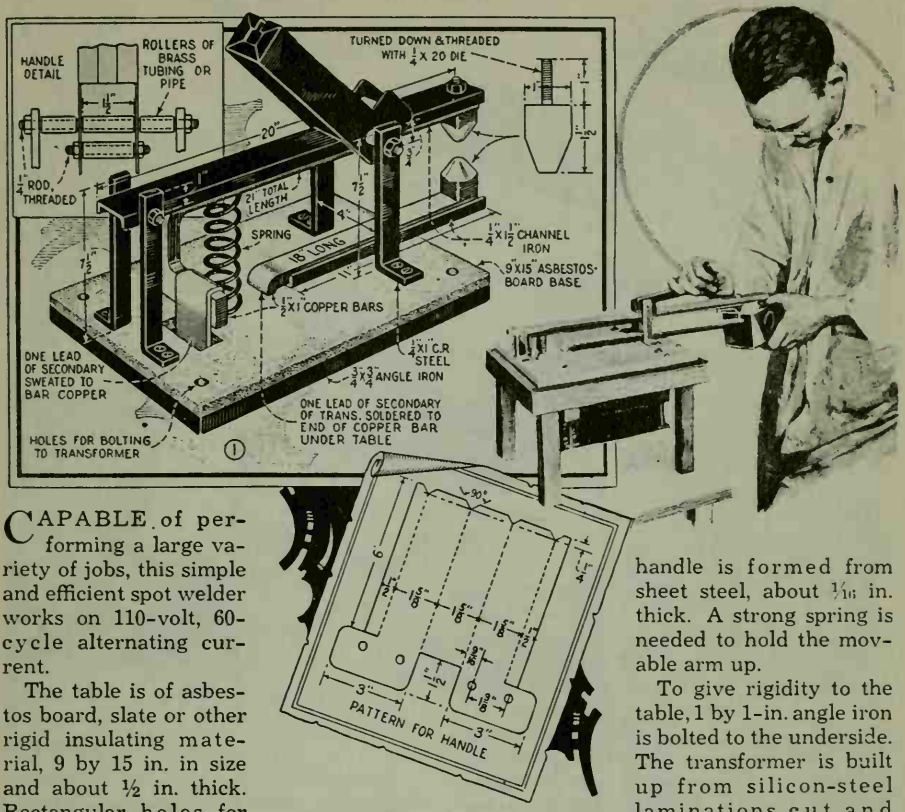


It's very important to attach the correct ignition wire to the terminal after cleaning and installing the plug



Clean the insulator after installing the plug to prevent sharts through caked dirt or hard grease

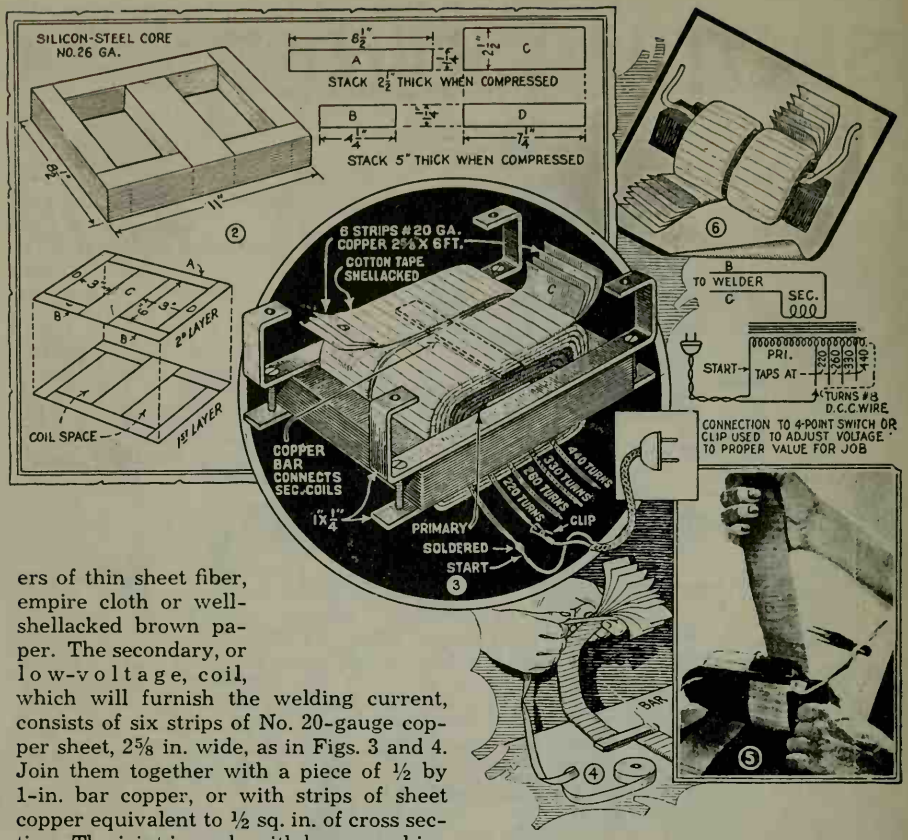
SPOT WELDER



CAPABLE of performing a large variety of jobs, this simple and efficient spot welder works on 110-volt, 60-cycle alternating current.

The table is of asbestos board, slate or other rigid insulating material, 9 by 15 in. in size and about ½ in. thick. Rectangular holes for the transformer leads are made by drilling inside of layout marks and knocking out the surplus material with a hammer and cold chisel. The corners of the rough holes may be made square with a rasp or file. When holes have been drilled for all the parts, the electrode brackets and the 1½ by ¼-in. channel iron for the bottom electrode may be bolted in place. The brackets are made from 1 by ¼-in. cold-rolled or mild-steel straps, bent and drilled as in Fig. 1. Copper bars to carry current to the electrodes are bent to shape from 1 by ½-in. copper, which should be annealed before and after bending. The electrodes are made from 1 by 1-in. square copper rod. They should be turned in a lathe or filed to the shape shown in the detail. It is very important that they make perfect contact with the copper bars. The control handle is formed from sheet steel, about 1/16 in. thick. A strong spring is needed to hold the movable arm up.

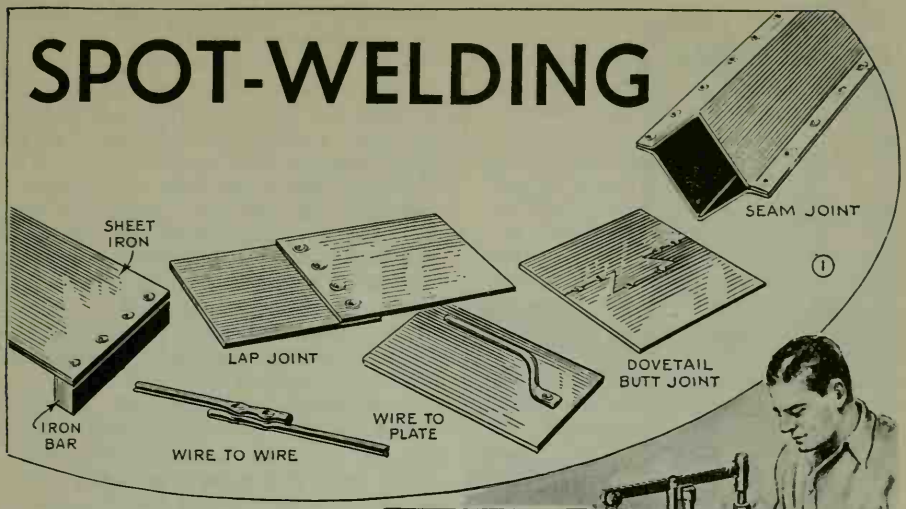
To give rigidity to the table, 1 by 1-in. angle iron is bolted to the underside. The transformer is built up from silicon-steel laminations cut and stacked as shown in Fig. 2. About 50 lb. of No. 26-gauge silicon-steel will be needed. After stacking the core to a thickness of 2½ in. when tightly compressed in a vise, bind the center leg with friction tape and remove the rest of the iron. The primary coil may now be wound. It consists of 440 turns of No. 8 d.c.c. wire. Taps are made at 220, 260 and 330 turns by binding the end of a 2-ft. length of No. 8 wire to the proper turn with fine bare-copper wire. The bound splice is soldered and taped, after which the winding is continued. When the primary coil has been completed, tie the end in place with cord and impregnate the coil with air-drying insulating compound, or shellac, by dipping the coil and allowing it to soak until the compound has penetrated. When the coil has dried, cover it with two or three lay-

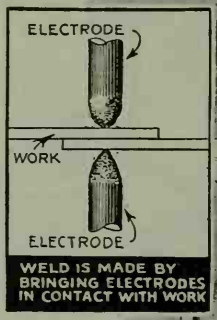


ers of thin sheet fiber, empire cloth or well-shellacked brown paper. The secondary, or low-voltage, coil, which will furnish the welding current, consists of six strips of No. 20-gauge copper sheet, 2⅝ in. wide, as in Figs. 3 and 4. Join them together with a piece of ½ by 1-in. bar copper, or with strips of sheet copper equivalent to ½ sq. in. of cross section. The joint is made with brass machine screws and is then soldered. A poor connection will cause heating and the transformer will burn out. Bind the bar to the primary coil so that it will be outside of the "window space" when the core is reassembled. Wind the two sections of secondary in opposite directions and with three turns each, as shown in Fig. 5: Fig. 6 shows the completed coil before being bound in place with friction tape. After taping, the coil should be thoroughly impregnated with compound and allowed to dry. When the core has been reassembled around the coil, a pair of brackets, as shown in Fig. 3, should be put in place. The ends of the secondary are sweated or brazed to the heavy copper bars carrying the welding electrodes. Tin the ends of each sheet of copper for a length of 3 or 4 in., and also the copper bars. Wrap the leads from the transformer secondary around the bars and bind them tightly with tinned copper wire after which they are sweated in place to make a solid joint. Flexible braided copper conductor can be used to connect the moving arm of the welder to the transformer. However, if a generous loop of the composite copper-sheet winding is left, this will not be necessary.

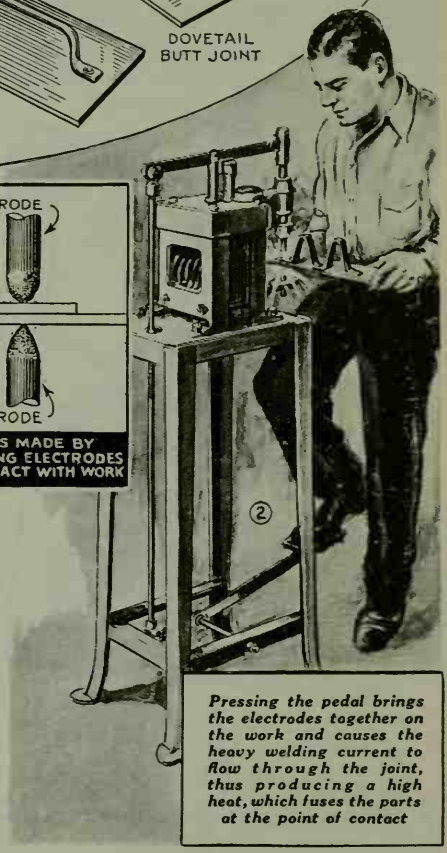
The cleaned work to be spot-welded should be placed between the electrodes, and the circuit completed by moving the handle toward the operator. The work will become white-hot in a few seconds. A slight increase in the pressure at this instant will complete the weld. In use, the electrodes will oxidize and wear away, but can be replaced or re-turned so that the diameter of the spot is not too large. The voltage may be adjusted to suit the job by changing the battery clip or switch, as shown in the diagram. If the two electrodes accidentally touch, quickly disconnect the outfit from the line.

SPOT-WELDING





WELD IS MADE BY BRINGING ELECTRODES IN CONTACT WITH WORK

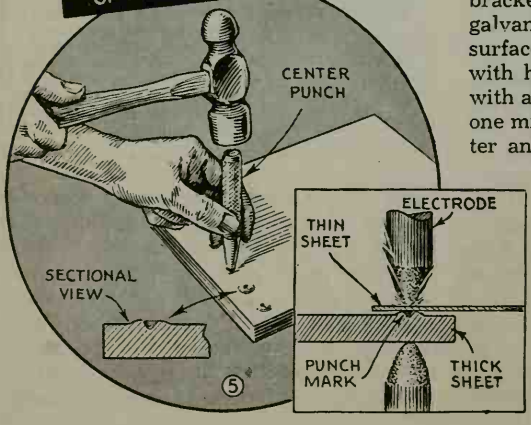


Pressing the pedal brings the electrodes together on the work and causes the heavy welding current to flow through the joint, thus producing a high heat, which fuses the parts at the point of contact

NEW possibilities in the field of sheet-metal work are open to a craftsman who is efficient with a spot welder. It enables him to build articles that he would not attempt to put together with other types of fastenings. Sheet-metal cabinets and shelves, small tables, tool racks and supports, cases, tackle boxes, and toys are among the many articles on which spot-welding can be used to advantage.

Spot-welding technique: Spot-welding is a simple process in which two metal parts are welded at a series of points or "spots" along the seam joint. The work to be joined is placed between the electrodes, or welding coppers, as shown in Fig. 2. Pressure on the foot pedal or hand lever brings the electrodes together, thereby pressing the parts into intimate contact and at the same time causing the heavy welding current to flow through the joint. The heat thus produced fuses the parts together at the point of electrode contact, producing a spot weld.

With a little practice, excellent welds on a variety of metals up to 1/16 in. in thickness can be made on small, low-priced spot-welding equipment. However, aluminum, copper, and alloys such as brass containing these metals cannot be spot-welded successfully on the type of machine usually found in the small shop, as their electrical resistance is too low to generate enough heat except on very high-capacity welders of special design. In spot-welding it is important to use the proper pressure on the electrodes and not to hold the current on for too long a time. If too much pressure is used, there will be a pronounced "dimple" at the spot weld, while if the current is left on for too long a time,



burning of the metal and sticking of the electrodes will result.

Preparation for spot-welding: It is essential in spot-welding, as in any type of welding, that the work be thoroughly clean and free from grease and oily matter. Scrubbing the metal with a stiff brush in hot soapy water containing a little washing soda will generally remove this oily film, Fig. 3. The work should be rinsed well in hot water to remove all soap, and then dried before welding. In some cases, additional preparation is necessary to remove plating, rust, scale, or other surface coating and expose a clean metal surface suitable for welding.

Spot-welding iron and steel: No pretreatment, other than removing the greasy film, is required in spot-welding cold-rolled steel. This metal is primarily a machine-shop material and the sketches in Fig. 1 illustrate time-saving spot-welded joints that can be made on this material. Hot-rolled steels and black iron can be welded in the same manner, but the black coating or mill scale usually found on hot-rolled steels is likely to cause flashing or sparking during welding, and also tends to weaken the weld. Warm, uncut hydrochloric (muriatic) acid applied on the area to be welded, after removal of the grease film, is usually sufficient to remove the interfering coating in about a minute. The acid should be rinsed off thoroughly in hot water as soon as the scale has been removed.

Galvanized iron: Zinc coatings on iron or steel tend to produce a weaker and more brittle weld and make corrosion of the electrode tips more rapid. Where there is any strain on the weld itself, such as in the brackets and supports shown in Fig. 4, the galvanizing must be removed from the surfaces to be welded by brushing them with hydrochloric (muriatic) acid diluted with an equal quantity of hot water. After one minute, rinse the acid off with hot water and dry the pieces thoroughly before welding. The weld can be protected against rust by a coating of good aluminum paint.

On small parts made of galvanized iron, in which there is no strain on the weld and strength is not important, it is possible to make a "tack" weld to hold the parts in position by spot-welding. However, the weld will be brittle

and it is recommended that the zinc coating be stripped off before spot-welding galvanized iron.

Tin plate (terne plate): Tin coatings on steel cause little or no interference, and a joint made by spot-welding tin plate is strong and durable. Cleaning other than removing grease is not necessary. Tin plate will be found excellent for making air ducts, vents, small boxes or containers, and numerous other articles on the spot welder.

Stainless steel: Since stainless steels have a high electrical resistance, spot-welding is one of the best methods of joining them. The welds are strong and the stainless properties of the finished object are not impaired at the joints by the addition of other metals, as is the case in other types of welds on stainless steel. The blue discoloration around each spot weld usually can be removed by rubbing the spot with fine emery paper and polishing either on a buffing wheel or by hand.

Applications of spot-welding: Spot-welding can be applied, in general, to any joint or seam in sheet metal in the various metals outlined above. While it is possible to spot-weld heavier stock, it requires very large currents and is beyond the capacity of small welding equipment. Fig. 1 shows a number of types of joints that can be made with a small spot welder. When thin sheets are spot-welded to thick sheets, the latter are center-punched as in Fig. 5. The punch marks tend to localize the heat and a good weld results.

SPRAY AIDES

Heating Lacquer Improves Spraying

You will do a better job of lacquering if the lacquer in the spray gun is kept thin by warming it occasionally during the operation. Do this by immersing the spray-gun jar in a pan of hot water for a few minutes. Because of the inflammable nature of lacquer, be sure that the pan of water is not over an open flame while warming the gun.

Right-Angle Fitting on Spray Gun Permits Its Use on Ceilings

By attaching a spray gun to the fluid cup by means of a street elbow or a right-angle brass coupling, the gun can be used for painting overhead surfaces that ordinarily cannot be sprayed. Thus fitted, the gun can be pointed straight up without excessive tilting of the fluid cup.

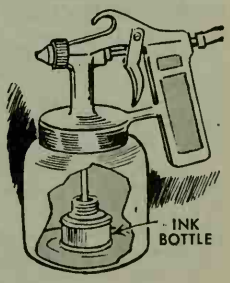
Keep Compressor Away From Job

In order to show the hook-up of the spray gun to compressor, many pictures of spray jobs show the compressor very close to the work. In spraying work, the compressor should be kept a practical distance away from the job to prevent clogging of the air filter by spray dust.

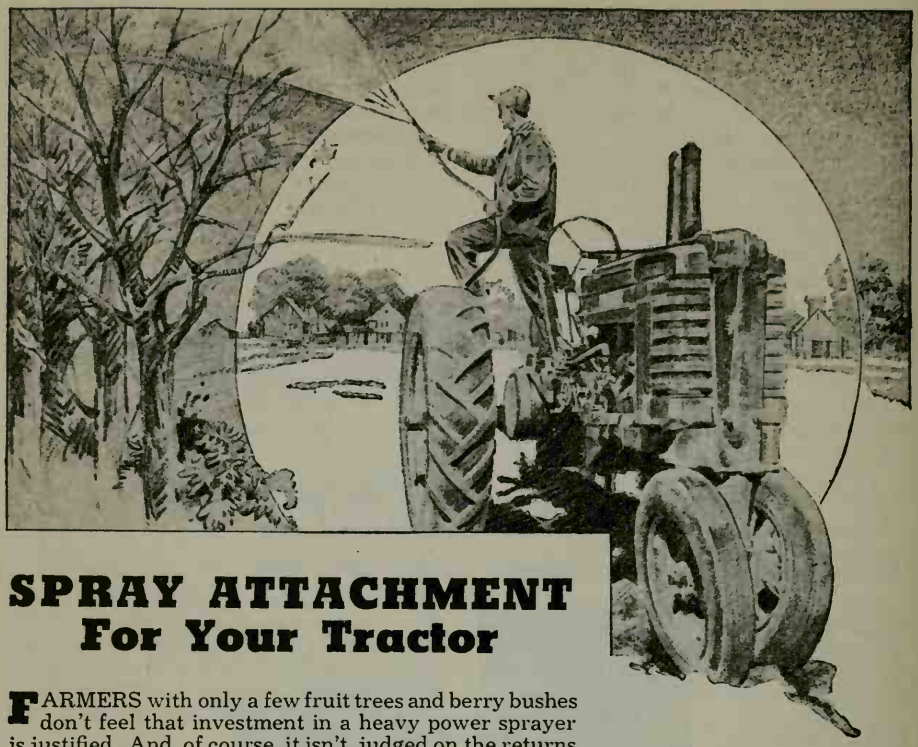
Nonbleeder Gun Changed to Bleeder by Tying Trigger

You can use a nonbleeder-type spray gun with a small compressor by simply tying back the trigger with string or a piece of wire. The pull-back should be just enough to pass air, but not fluid. Rigged in this manner, the gun will allow air to escape and thereby eliminate the compressor overload which would be caused by the nonbleeder gun.

Ink Bottle in Paint Sprayer Saves Cleaning Cup

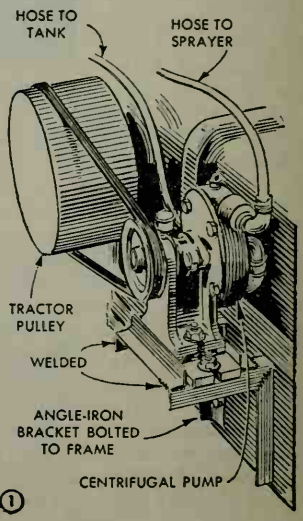


Time wasted and paint lost in cleaning a sprayer cup after painting small objects can be saved. An inner container such as an ink bottle can be partially filled with the desired color and set inside the cup of the sprayer.



SPRAY ATTACHMENT For Your Tractor

FARMERS with only a few fruit trees and berry bushes don't feel that investment in a heavy power sprayer is justified. And, of course, it isn't, judged on the returns from the outlay. But the bugs and various scales that attack fruit trees and shrubs don't bother with any such practical considerations. They can ruin a valuable fruit or shade tree or a row of prized berry bushes in a single season if you give them half a chance. So far there seems only one effective control—spray and more spray, applied at the right time. And on the farm, with other work always waiting, spraying must be done as quickly and effectively as possible. By making use of the farm tractor and a small centrifugal pump you can put together a mobile spray unit with a reach of 30 to 40 ft. and sufficient pressure at the nozzle to give the proper spread. As most farm tractors of the "tricycle" or cultivating type are fitted with side frames so that you can mount implements or other attachments on either or both sides, it's easy to attach brackets and mount a small centrifugal pump on the belt-pulley side and take power from the pulley with a V-belt as in Fig. 1. Then on the back of the tractor you mount a 55-gal. oil drum to serve as a tank. Run a suction hose from the tank to the pump and another of convenient length to a spray nozzle. Fit it with a brass extension if you want to get up high in tall trees, and you have a simple spray rig that will do efficient work.



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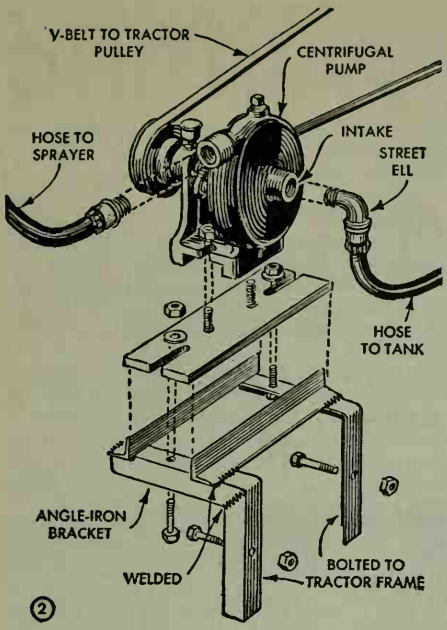
Brackets to mount the pump on the tractor frame can be made from angle iron as in Fig. 2. No dimensions of these parts are given because sizes depend on what pump you use and what tractor it is mounted on. Any small centrifugal pump with a ¾-in. intake and ½-in. discharge will serve the purpose. Use ordinary garden hose between the tank and the pump intake. Weld a garden-hose connector on the side of the oil drum ¾ in. above the bottom. If you strain the spray material before pouring



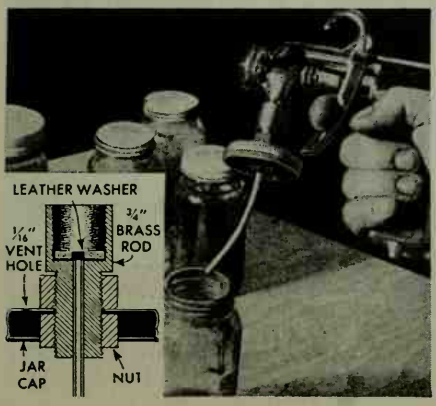
Use any small centrifugal pump with a ¾-in. intake and ½-in. discharge. Weld a hose connection to the 55-gal. steel tank ¾ in. above the bottom and connect the pump to the tank with ordinary garden hose

in the tank, it will not be necessary to fit a strainer screen. Use spray hose between the pump and nozzle. Any spray nozzle with a hand-operated shutoff valve will do. Or an ordinary garden spray nozzle with a snap-action adjustment may be used. No by-pass valve is needed unless you shut off the spray at the nozzle frequently with the pump running. It is usually easier to throw out the tractor clutch and stop the pump, whenever necessary, than it is to install a by-pass valve.

Pressure at the nozzle will vary with the speed of the tractor engine. The higher the speed, the greater the pressure. The pump pulley should be about ⅓ the diameter of the tractor belt pulley. Small centrifugal pumps usually deliver greatest efficiency at fairly high speeds, and by using a small pulley on the pump it won't be necessary to race the tractor engine.

Spray Gun Altered to Take Small Cans of Paint

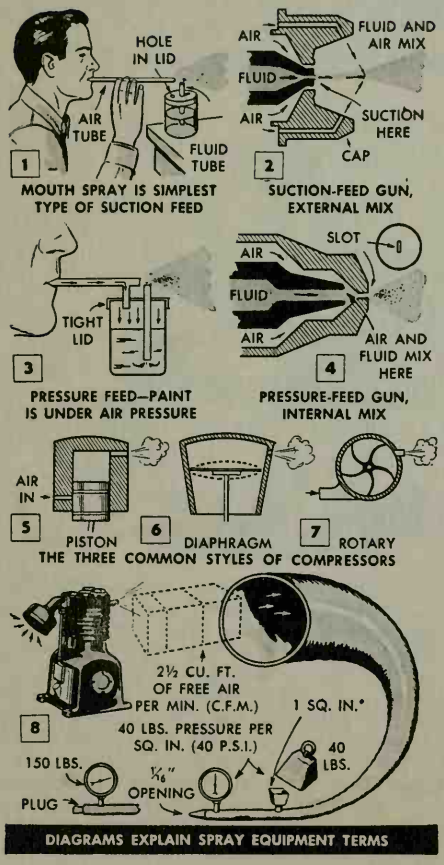
In my work as a modelmaker I use many colors of paint which are purchased in 3 or 4-oz. glass jars. To save time and prevent the waste of paint, I altered my spray gun so that the paint jars could be substituted for the regular jar on the gun. To do this, I made an auxiliary suction tube, as shown in the detail, to take the smaller jars. One of the small jar covers was clamped between nuts on the tube so that the paint jars could be screwed to it. This permitted the various colors of paint to be used right out of the original jars.



Portable Spray Rig for Garden Made From Wheelbarrow

Using a wheelbarrow, an old hot-water tank and the necessary spray pump, you can make a portable spray rig that has a large capacity. Cut the tank in half and rivet a clip on the side to hold it in the barrow. It will be necessary to cut a hole in the bottom of the wheelbarrow so the tank will set in it. A standard spray pump is bolted to the inside of the tank in such a position that the handle can be worked easily. When not in use as a sprayer, the pump unit is removed and the hole in the wheelbarrow is covered with a piece of metal.

SPRAY PAINTING



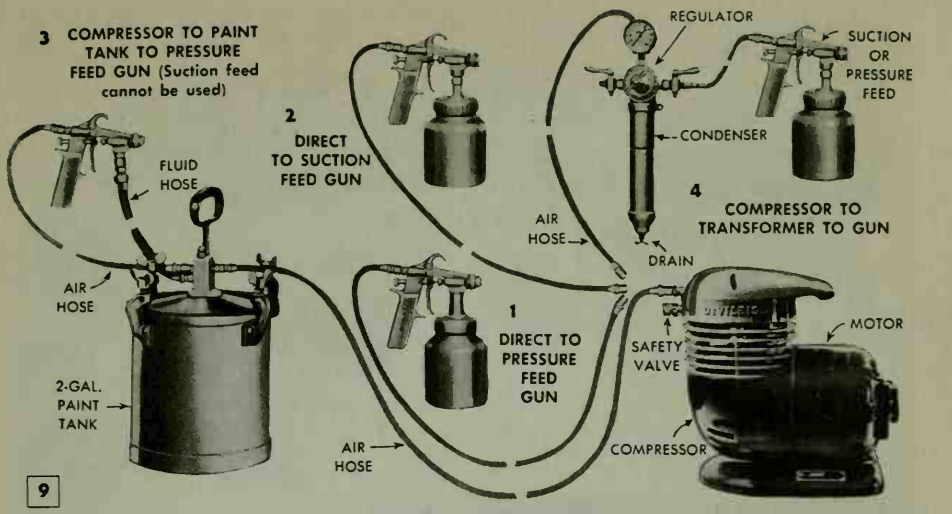
SPRAYING is the modern way to paint. It is three to 10 times faster than brushwork and gives a smooth, dust-free finish hard to obtain by other methods. However, it is not for every job, nor is one kind of spray gun suitable for all kinds of spray finishing.

Spray guns: Spray guns can be classified as either suction feed or pressure feed. A mouth spray, Fig. 1, is a simple example of suction feed, and some inexpensive guns use suction feed in exactly this form, as can be seen in Fig. 12. In more expensive guns, the suction is created at the nozzle, Fig. 2, while air from horn holes on the cap blows the paint out to form a fan pattern. Since the air and paint mix outside the cap, this kind of construction is called external mix.

Fig. 3 shows the principle of pressure feed. Since the paint is under air pressure, it is possible to spray heavy-bodied materials. Fig. 4 shows the nozzle commonly used on the pressure-feed gun. Air and fluid mix inside the cap, hence it is called internal mix. Internal mix always means pressure feed, but pressure feed can be used with either internal or external mix. A pressure gun can be recognized by the fact the paint-cup lid is solid, whereas the lid of a cup for suction feed must have a hole in it to admit air as paint is exhausted.

Either suction or pressure-feed guns can be of the bleeder or nonbleeder type. A bleeder gun passes air at all times, the trigger controlling flow of fluid only. A spray gun used with a portable air compressor should be a bleeder in order to keep the compressor from overloading. On the other hand, a tank outfit, Fig. 11, takes a nonbleeder gun since a bleeder would exhaust the air in the tank even when not in use.

Compressors: The air-compressing unit is commonly of the piston, diaphragm or rotary type. The metal piston, Fig. 5, is the best construction and represents the only type suitable for heavy-duty equipment. The rubber diaphragm, Fig. 6, is excellent for light duty. It requires no oil like the moving metal piston, and is less expensive and lighter in weight. The rotary type, Fig. 7, is used with direct electric drive. This type has less capacity than piston or diaphragm, but does have the advantage of direct drive and compactness. The motor is sometimes a separate unit, Fig. 14, or can be built into the spray gun



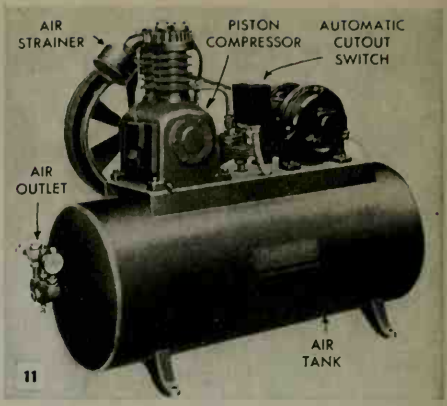
FOUR HOOK-UPS for painting with a portable spray outfit. Direct hook-up, Nos. 1 and 2, is used for most work. Paint tank, No. 3, is useful for big jobs. Set-up with transformer is ideal for homeshop lacquer work

Air volume and pressure: A compressor is rated on the amount of free air which it can produce in one minute. A piston or diaphragm compressor powered with a ⅓-hp. motor will produce about 2½ cu. ft. of free air per minute, Fig. 8. This true value should not be confused with displacement, which is the theoretical air production at 100 percent efficiency, amounting to about 4 c.f.m. for the unit mentioned.

If 2½ c.f.m. of air is delivered to a pipe or hose and exhausted through an opening a little under 1/16 in. diameter, it will maintain an air pressure of about 40 lbs. per sq. in. (40 p.s.i.). If the size of the exhaust opening is increased, the pressure will drop; if the opening is reduced, the pressure will be higher, within the limits of the compressor to stand the load and keep pumping. If the exhaust opening is closed entirely, as shown at left in Fig. 8, the air pressure will immediately jump to about 150 lbs. and the compressor will be overloaded and the motor eventually will stall. To prevent this possibility, a ⅓-hp. compressor usually has a safety pop-off valve set at about 50 lbs. For best results, a spray gun and compressor should be purchased as a unit—the gun should suit the capacity of the compressor.

What equipment is best? If you are buying just one spray gun for all kinds of spray painting, it should be pressure feed because only pressure feed will spray heavy paints and enamels. On the other hand, internal mix, which is usually a part of pressure feed, prohibits the use of fast-drying materials, such as lacquer, because the paint dries inside and around the cap opening. So, if you want to spray lacquer, it must be from a suction gun. A suction gun is also advantageous in that it can be used with a variety of glass jars, whereas the pressure gun requires a metal cup. Suction-feed guns can be cleaned from any open container, Fig. 13, while the pressure gun can only be cleaned from the standard metal container. Thus, the whole picture is that the suction gun is cleaner and more convenient to use, but will spray only lacquers and light-bodied materials. The pressure gun, while a little less convenient, will spray any weight of material used in brush painting except fast-drying lacquer.

The compressor for homeshop or utility work should be ¼ or ⅓ hp., either diaphragm or piston type. The unit should be capable of holding 35 to 40 lbs. of air pressure. In this respect, however, it must be said that air pressure is needed only for atomization of the paint and there is no agreement among sprayers as to what constitutes the right pressure. Industrial sprayers using suction guns with plenty of air supply often spray at 80 to 100 lbs. pressure, with a low average of about 60 lbs. The homeshop worker gets along nicely with 35 lbs. or even less. Excellent spraying can be done with 30 lbs. pressure, while lacquers and stains are readily sprayed with 20 lbs. pressure. With a pressure-feed gun, a very low volume of air will put out paint and even a small amount of air will give enough pressure for fairly good atomization. Many of the lighter spraying devices—magnetic coil, direct electric, CO_2



Above, ⅓-hp. diaphragm compressor with pressure-feed gun. Below, ¼-hp. diaphragm compressor with suction gun. Right, piston compressor with air tank

gas, etc., are quite satisfactory for spraying light-bodied materials.

Four hook-ups for spraying: Fig. 9 pictures a composite view of the four common hook-ups for spraying with a portable spray-paint outfit. The commonest set-up is the direct connection from compressor to spray gun, like Nos. 1 and 2. No. 3 is used only with a pressure-feed gun and amounts to disconnecting the pressure-feed cup and substituting a much bigger "cup" with suitable fluid hose connection to the gun. With a set-up like this, you can put a whole gallon can of paint in the paint tank, Fig. 16, and spray away without the bother of refilling the cup and without the weight of the cup. Of course it is more bother to set up and clean, hence is usually confined to big jobs of wall and house painting. Set-up No. 4 is ideal for homeshop use. The air goes from compressor to transformer and then to the spray gun. The transformer consists of two parts: a regulator, which can be used to set any pressure within the capacity of the compressor, and a condenser, which filters out moisture and oil in the air supply. Actually there is very little need for the regulator since most spray jobs require the full air supply. However, it does provide a handy check to see if the compressor is performing as it should. The condenser is invaluable when spraying lacquer in muggy weather—it eliminates that possible drop or two of water from spitting from the gun and spoiling the job. A condenser can be purchased without the regulator if desired. If you do spray work exclusively at a fixed location, a tank outfit, Fig. 11, is worth considering.

Accessory equipment: In accessory equipment, a most handy gadget is the angle head, Fig. 15. This is commonly available only for pressure-feed guns since it is used for floor and ceiling work normally done with pressure feed. The angle head permits spraying directly at the ceiling surface without undue tilting of the gun—it works wonders in reducing dusting when using water-mix paints. Also available for most pressure-feed guns is a round cap, that is, a cap with a round hole in it to produce a round spray. It is sometimes useful for stencil work, spot spraying and any type of work which can be sprayed better with a round pattern instead of the fan pattern produced by the standard slotted cap.

An extra air hose with a coupling to make the connection is a worth-while investment. The average air hose is about 10-12 ft. long—two together give extra reach which is sometimes needed. A respirator? Yes, if you do extensive interior work in crowded quarters where dusting may be excessive, but for average homeshop work it is more bother than it is worth. Don't forget a condenser if you are doing fine furniture finishing, especially with lacquer. And—above all—get a few extra paint containers. This is where a suction gun is nice because pint and quart fruit jars will usually fit the cup-lid threads,

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Spraying solvent will clean a suction-feed gun. Below, a 1-gal. can of paint fits inside a 2-gal. paint-gun tank nicely

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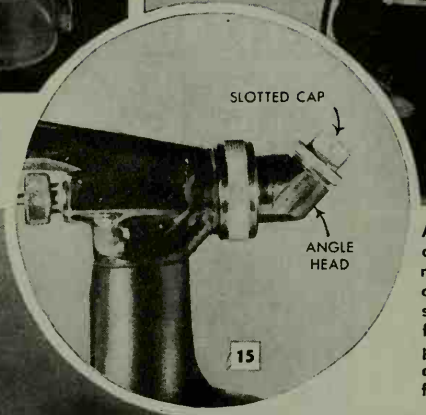

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A direct electric spray-gun outfit works from universal motor, develops about 20 lbs. of pressure. Center photo shows an angle head, a useful auxiliary nozzle for a pressure-feed gun. Below, duster gun comes in handy for cleaning shop machines

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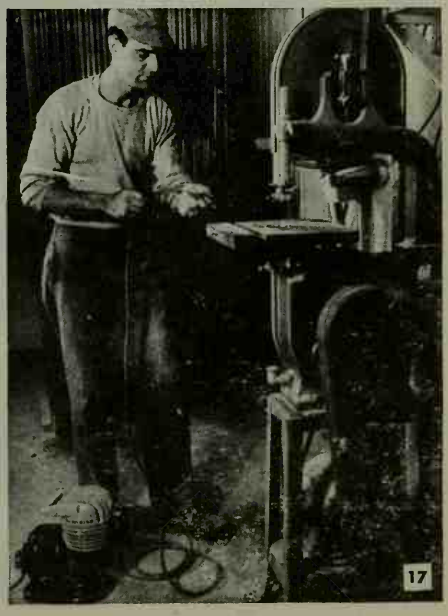
while smaller glass jars can be readily adapted. Because of the internal pressure involved, the pressure-feed gun is safe only with a metal cup. Buy at least one extra cup if you have a pressure gun so that you will have a spare can for use in cleaning the gun. Most extra spray-gun containers are fitted with airtight closures so they can be used for storing paint if desired. As a rule, however, this is poor practice since the paint often skins over in the can and makes more work in cleaning. An air-duster gun, Fig. 17, is a useful gadget. This is an inexpensive gun which passes air only. It is just the thing for dusting shop tools, blowing out motors, etc. Good dusting can also be done with the regular spray gun except it does not have a pointed nozzle to get into tight corners.



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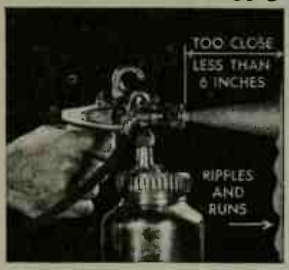
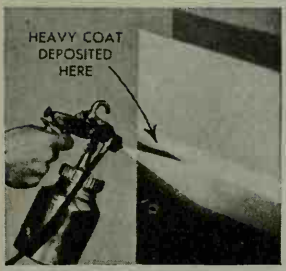
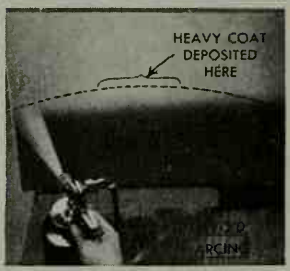
"Manual of arms" for SPRAY



GET THE RANGE!

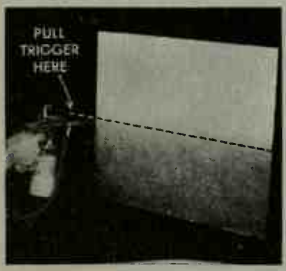
Holding the gun too close causes an uneven coat, air ripples and possible runs. If the gun is held too far from the work results are dry, sandy spray and excessive dusting. With average home shop equipment, a distance of 7 or 8 in. from the gun to work gives good results





ANGLE OF FIRE

Gun should be held "square-on" when spraying verticol panels. Pointing down, as shown at extreme left, deposits heavy coat along upper edge of spray pattern. At left, keep same distance from work throughout stroke—arcing deposits a heavy coat at the center of the stroke

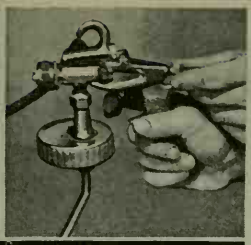


CORRECT TRIGGERING

Pull the trigger before your gun stroke hits the work; do not release trigger until gun stroke has passed work. Practice triggering to hold overspray at ends to a minimum. Banding panel ends previous to horizontal stroking is good practice and reduces overspray

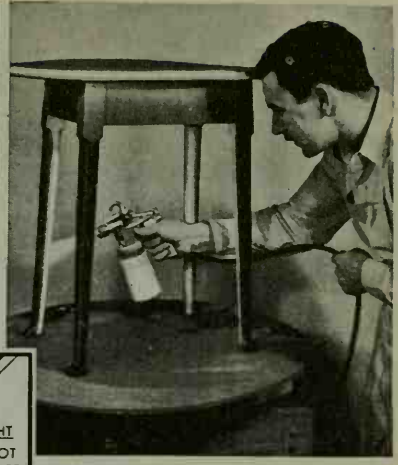
HIT THE FRONT LINE!

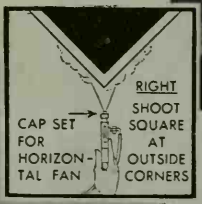
When spraying horizontal surfaces, start at the near edge. Spray dust then is projected forward to land on uncoated work where it is dissolved by full spray stroke. Starting at far edge is wrong as it shoots spray dust onto the finished surface coat causing a rough finish



CHECK POSITION OF FLUID TUBE AND MAKE GUN ADJUSTMENTS

GUNNERS



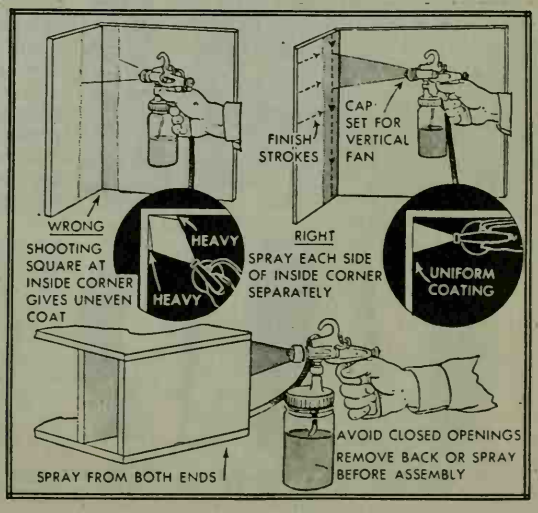


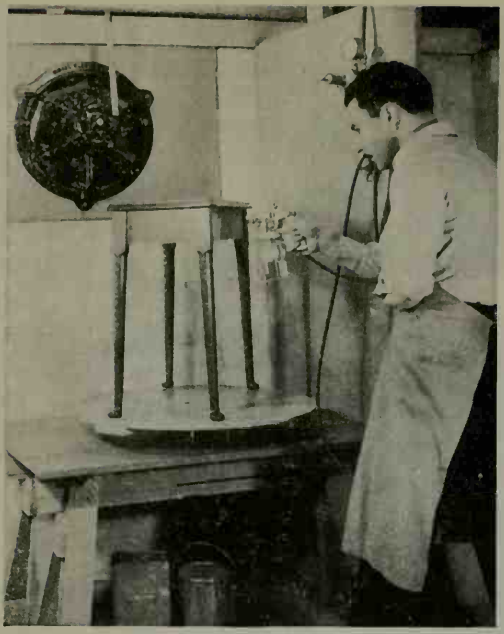
CLEAN UP OUTPOSTS FIRST

If you shoot the edges and other out-of-the-way places last, you will have a lot of spray dust falling on surfaces already coated. The right way is to shoot edges and similar surfaces first, as spray dust falling on uncoated main areas is dissolved by later full spray coat. Turnings should be sprayed with an up-and-down stroke, with air cap of gun set for vertical fan (horn holes horizontal). Make use of a simple turntable—walking around the work or shifting it by hand is poor practice. Always spray full wet coats just short of running and work under a good light so that you can actually see the finish as it goes on

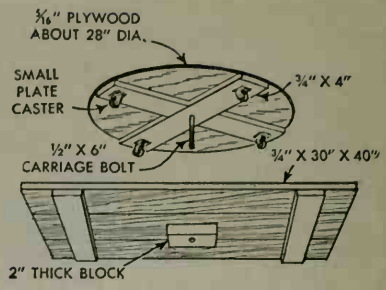
GUNNING CORNERS

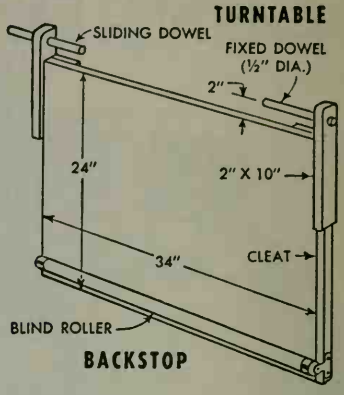
Shoot square-on at outside corners. This deposits a heavy coat at the corner edge where it is needed. The air cap of gun should be set for horizontal fan. Finish the job with horizontal strokes. Don't shoot square-on at inside corners. This deposits a heavy coat at either side of corner. The right way is to shoot each corner in turn, as shown at extreme right, with air cap set far vertical fan. Finish the surface with horizontal strokes, triggering each stroke to minimize overspray on coated surface. Avoid closed or box openings. It is almost impossible to prevent dusting when you shoot right into them. On many jobs you can remove back panel and spray from both ends of opening



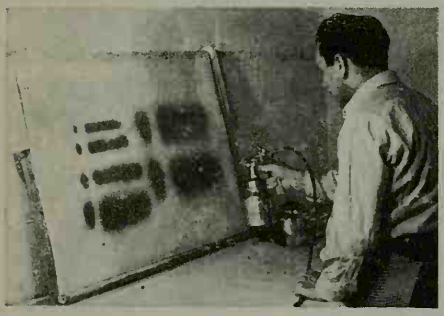


Homeshop installation in a semienclosed booth with an exhaust fan in a basement window. The simple turntable is mounted on trestles. A transformer assures clean air supply



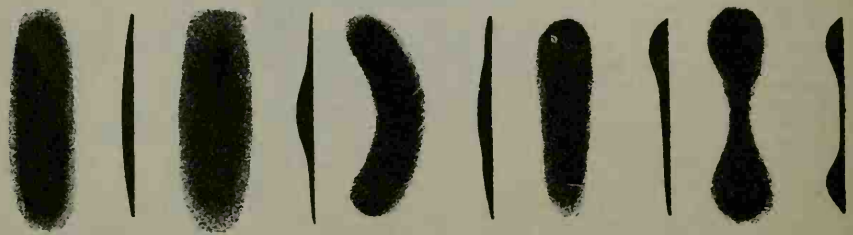


How to Handle SPRAY JOBS

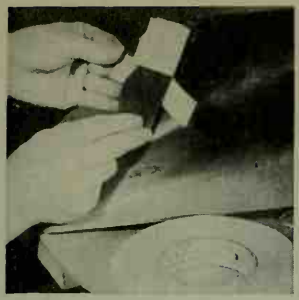


SPRAY FINISHING is 75 percent preparation time. With the surface properly prepared and with the job set up to eliminate unnecessary handling, the average piece of furniture can be sprayed in about 10 minutes. In fact, if you work with lacquer, the job must be sprayed fast for good results.

Homeshop installation: The ideal homeshop installation is the separate finishing room, equipped with exhaust fan, turntable and paint cabinet. Second choice is a spray booth located near a basement window to accommodate an exhaust fan. An



EVEN PATTERN | HEAVY-CENTER PATTERN | PEANUT PATTERN | HEAVY-END PATTERN | SPLIT PATTERN

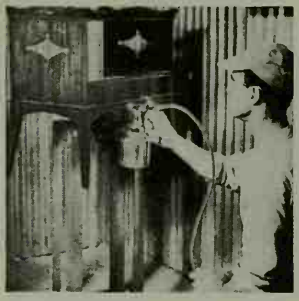


MASKING TAPE is used to protect parts which are not to be painted

STRING SUPPORTS provide a good set-up for certain kinds of work

OUTDOOR JOBS should be clear of the ground to avoid dust and dirt

FENCES should be angle-sprayed to catch face and edge in one stroke



SMALL TURNTABLE is often better than large one for furniture jobs

LOW DOLLY on casters is set-up preferred by many spray painters

installation of this kind is shown on the opposite page. The compressor unit is a ⅓-hp. diaphragm, with an air hose leading to the transformer. The turntable is an important piece of equipment, since it eliminates a lot of dancing around the job. A backstop is a handy auxiliary. It can be used as a backstop for the turntable or it can provide a complete spray set-up in itself. The paper used is standard newsprint, available in 4 to 8-lb. end rolls at any newspaper office.

A good exhaust fan is expensive, so most craftsmen get along without this piece of equipment. Spraying without a fan is best done with two basement windows open to provide ventilation. It is convenient to work directly under a window since gun cleaning can be done through the window opening if desired.

Spray test pattern: Always spray a test pattern before starting actual work. This can be done on the backstop or on a piece of cardboard. If you are new at spraying, it is a good idea to make a series of test patterns, as shown in the photo on the opposite page, in order to become familiar with the capacity of your gun. By adjusting the fluid flow, most guns will spray patterns from 1 in. to 24 in., measured the long way of the fan. You will note that as the pattern size is increased, the pattern becomes more ragged and the breakup or atomization of the paint becomes coarser. Hence while a pressure-feed gun powered with a ⅓-hp. compressor will blast a pattern 2 ft. wide, it is impractical to use this width. A pattern 10 to 12 in. wide is about the maximum, and that only for wall surfaces. Furniture and similar work are best done with a 5 to 6-in. pattern.

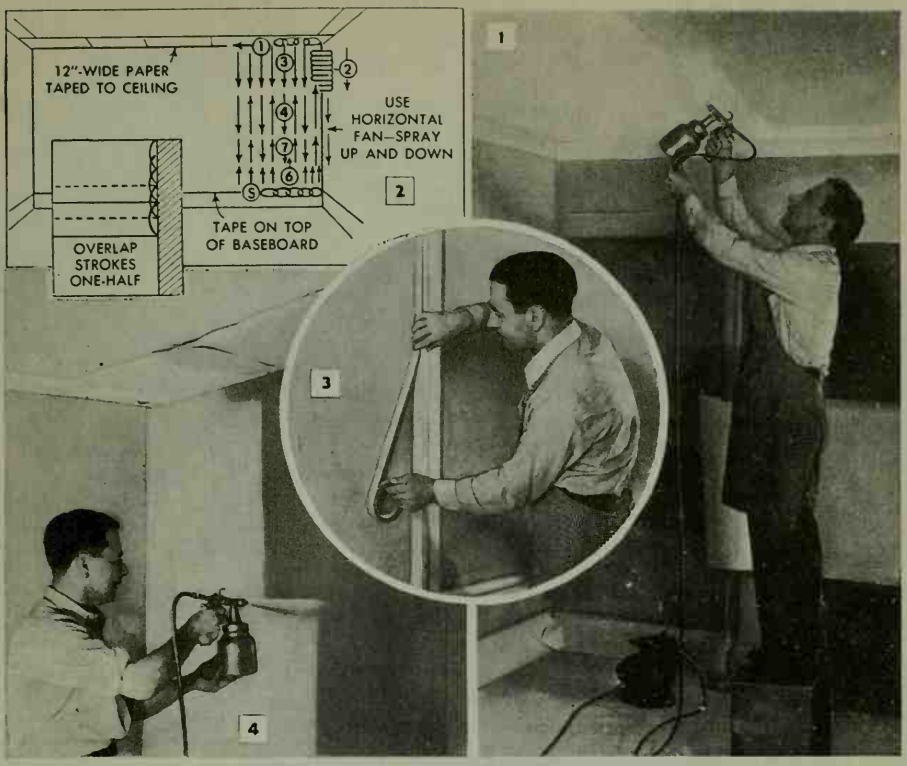
Of the various faulty patterns, the heavy center is the most common, especially in connection with a suction gun or with a small compressor. It is a simple case of not enough air. The pattern can be improved by reducing the fluid flow, thus allowing what air there is available to work on a smaller quantity of material. Usually, however, complete correction is obtained only by diluting the paint. Satisfactory spraying can be done with a heavy-center pattern providing the fault is not excessive. The peanut-shaped pattern indicates clogging of one of the horn holes of a suction gun. A heavy-end pattern is caused by clogging at the center opening of the air nozzle. Various other oddly shaped patterns are caused by a dirty gun, and the obvious remedy is thorough cleaning. The split pattern is rare because it results from either too much air or an excessive width of pattern. Never try to spray with a poor

Knife-cut stencils after applying paper to work with rubber cement. Rub off excess cement in spray areas. Work smaller designs on wide masking tape or on duplex stencils

pattern or a spitting gun—you'll only succeed in getting a poor job. If you are using a suction gun, it is often advisable to spray a test pattern with lacquer thinner. An even pattern shows that the gun is not clogged and is ready to go. Then, if the test pattern with the actual finishing material is not satisfactory, it is a plain case of the material being too heavy.

Selection of material: The spray gun is used to apply hundreds of materials originally designed for brush application. While there is nothing wrong with this picture, the spray gun is at its best when used with fast-drying materials designed for spraying only. Tops in this respect is lacquer, most types being dust-free a minute or two after application. Using lacquer you can do perfect, dust-free work right in the middle of a sawdusty basement. The finish itself is tough and durable; the lacquer left over keeps perfectly. One fault with lacquer is that it does not have good build or body—one coat of synthetic is worth two or three coats of lacquer. So, perhaps you will prefer the synthetics. In spraying grades, the drying time ranges from about 20 min. to 4 hrs. Most of the popular 4-hr.-drying enamels and varnishes intended for brushing are satisfactory spraying materials. As told in the story on equipment, the heavy-bodied synthetics require pressure-feed guns, while the fast-drying lacquers or synthetics require external mix. Unless you buy at least two spray guns, the selection of spraying material becomes automatic with the selection of equipment. Purely personal: The editor's own choice for a one-gun homeshop would be lacquer; the gun, therefore, suction feed. Lacquer poses somewhat more of a fire hazard than synthetics. However, all paints burn, and it cannot be said that lacquer requires greater precautions than those required for synthetics or oil paints. Common sense dictates that you never spray near an open flame: neither do you smoke when handling lacquer or lacquer thinner.

Masks and stencils: Every sprayer needs a roll of masking tape, the ¾-in. width being the most practical. This is used to protect all areas which are not to be painted and can also be used for striping and two-tone work, as described on other pages. Masking tape can be obtained up to 3 in. wide at most paint stores. The wider tapes are excellent for knife-cut stencil work. The gummed paper used to protect sheet plastics is also excellent for this kind of work. Similar papers can be purchased in duplex form, that is the gummed paper is mounted on a backing and can be stripped off for application to the work before or after cutting the stencil. Large designs, such as the firescreen above, are best worked with plain paper, using rubber cement to fasten the paper to the work. The stencil is then cut out and any surplus cement is rubbed off. Loose paper stencils are often useful.



Spraying Walls *and* Woodwork

SPRAYING interior walls and woodwork would be a wonderful thing if the spray-dust nuisance could be eliminated. Whenever you spray, however, some of the paint dust always gets in the air to land finally on every square inch of exposed surface. To the person who has never sprayed a room it is hard to evaluate the spray-dust problem—all in one breath you can say it is very bad and it is not so bad. Certainly if you move the furniture out and cover the floor, dusting is nothing to worry about.

Masking: This is a necessary evil in spray work. Generally the time and expense are compensated by cleaner, faster work. If you are spraying walls, the edges of woodwork should be masked, as shown in Fig. 3. Tape should be applied around the top of the baseboard, and it is also a good idea to add a paper skirt to cover all of the baseboard and base shoe. The floor must be covered from wall to wall. This can be done with old newspapers. Better, use roll ends of newspaper stock which you can buy at any newspaper office.

Gun and materials: The spray gun should be the pressure-feed type, powered with a ½-hp. compressor. This equipment in any make will handle any kind of wall paint at can consistency. A suction gun will not handle heavy paints; then, if the paint is thinned, you are certain to get poor coverage, and the ugly marks called "sags" and "curtains." An angle head is a positive must for ceiling work—it allows you to spray straight up without excessive cup tilting. The paint you use will probably be water-mix or one of the standard oil or synthetic wall paints. Water-mix paint is ideal in all respects except that it dusts a little more than some of the others. Special spraying materials such as Glidden Spray Daylight and Pittsburgh Spray Flat White offer advantages of fast drying and least dusting.

Spraying the ceiling: The ceiling comes first. This is easily worked with an angle head and you can do the average room standing on a box or chair, Fig. 1. A plank with two boxes or two chairs are sometimes better, especially if you are using oil paints,

Cutting-in at top of basement wall is easily done with cardboard shield. For most jobs, the use of shield plus masking tape is the approved method for doing clean spray work

which require more care in application in order to avoid lap marks from showing. If it's water paint, you simply throw it on willy-nilly, but oils should be worked the narrow way of the room in a strip about 3 ft. wide. A systematic coverage, always working to a wet edge, is just as essential in spraying as in brushing if you want to avoid lap marks when using oil paints. When you have finished the ceiling, get out of the room until the spray dust on the floor covering has dried. This is where water-mix and some spray whites are nice—the dust is dry when it hits the floor. All oils will be tacky for a time.

Walls: The easiest wall-to-ceiling joint is the drop ceiling—all you need is a strip of tape and a cardboard shield. Most difficult to spray is the square-to-corner, which properly requires masking with tape and a skirt applied to the ceiling, as can be seen in Figs. 2 and 4. On some jobs you can do masking with a straightedge alone, jamming the edge of a shield into the corner, but there is always the danger of a blow-under to spoil the ceiling. Basement walls commonly have a ledge at the top of the concrete and are easily worked with the cardboard shield alone, as in Fig. 5.

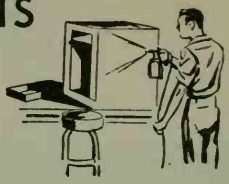
You can use any number of different techniques in covering a wall surface. If you are using water-mix paint, the only rule is "get it on." Other paints which may show laps must be worked more systematically. Since a horizontal pattern must be used in cutting in at the ceiling and baseboard, many sprayers continue with the horizontal pattern for the whole job, spraying up and down. Fig. 2 shows the sequence of operations. You start by running a single stroke at the ceiling joint. Then, run one stroke square into the corner, favoring the wall on which you are working. Next, use down strokes only from the ceiling to give better control at the ceiling joint. Work up and down for the rest of the way until you reach the bottom, which takes one stroke across the joint and then up strokes to finish. Work a strip about 3 ft. wide in this manner and then do another strip.

Cutting-in at vertical edges of windows and doors requires a vertical fan. Tape plus shield do for the masking. The gun stroke starts at the tape and moves out horizontally about a foot to get safely clear of the woodwork. Since this cutting-in requires a horizontal stroke, the usual procedure is to continue with the horizontal stroke for at least a part of the adjacent wall. In all cases a horizontal stroke with the gun is easier to control than a vertical stroke. In view of this, some sprayers cut in with the vertical stroke only as needed, using the horizontal stroke for all other areas. Always take the few seconds needed to rotate the spray-gun cap to suit the edge being sprayed. Also, it is always good practice to cut down the size of the spray pattern for cut-in work—3 in. is plenty big. The pattern size for wall areas should be 6-8 in. Best coverage is obtained with a one-half overlapping stroke, as shown in Fig. 2. This also simplifies gun handling, since the aiming line for each stroke is the edge of the paint previously applied.

Woodwork: Everything said about walls applies also to woodwork. The only difference here is that the tape goes on the wall. Usually if you are doing both jobs, the wood is sprayed first, letting the paint fan out on the sidewall without masking. Window glass should be masked with tape plus a square of paper in the center overlapping the tape. Tape on glass should be stripped as soon as the paint has set; if left on overnight moisture condensation on the glass may make it difficult to remove.

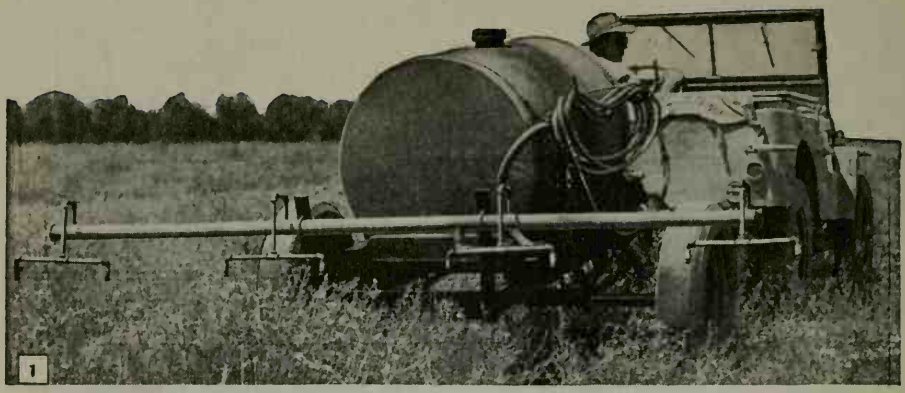
Spraying RECOMMENDATIONS

Data given here applies specifically to a spraying outfit working on 2½ cu. ft. of air per minute at 35 lbs. pressure per square inch. With such a unit and with a pressure-feed gun, any material of brushing consistency can be sprayed without thinning.

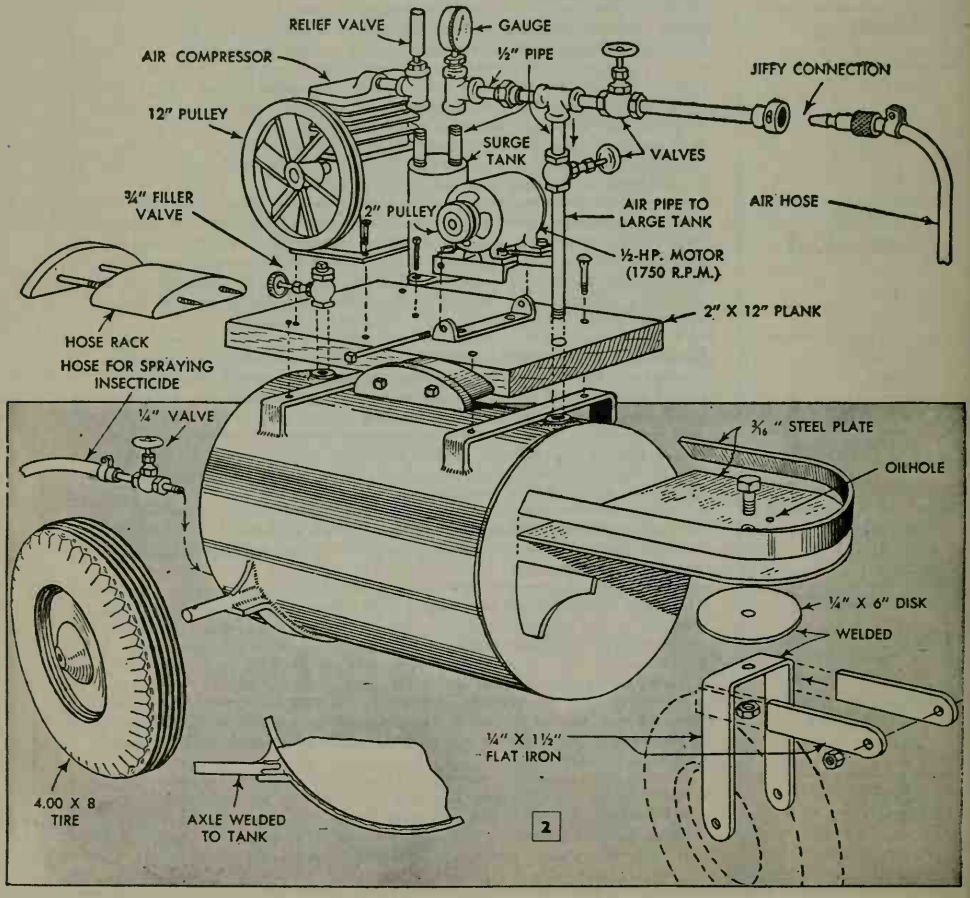


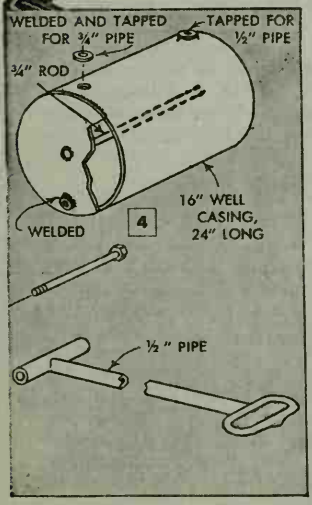
material	*spray application*
CEMENT PAINT	This material settles very quickly in the can and properly requires agitator equipment for good spraying. However, small jobs can be worked from a cup gun by frequent shakings. Thin a little more than brushing recommendation. Always strain, using 18 to 24-mesh screen. Clean gun thoroughly with water, then flush with turpentine or lacquer thinner
ENAMEL	Usual 4-hr.-dry product is a synthetic and can be sprayed pressure feed at can consistency. Avoid thinning unless specified. Apply full wet coat but beware of sags. Do not attempt to cover in one coat if the material lacks good hiding quality. Can usually be double-coated (see Synthetics) for heavier film thickness
HOUSE PAINT	Spray at can consistency, pressure feed. Do not dilute unless job requires. Avoid windy days. Old work requires good surface preparation
LACQUER	Reduce clear lacquer about 25 percent and pigmented lacquer 100 to 150 percent, depending on type. Suction feed, external mix should be used (internal mix will clog). Material can be thinned to any extent since almost instant drying eliminates sags and runs which would occur with other thinned materials. Always spray full wet coats. Use a fairly small pattern of about 5-6 in., holding gun 6-8 in. from work
OIL-MIX WALL PAINT	Pressure feed only. Spray at can consistency; avoid thinning unless specified. Spray flat whites, such as made by Pittsburgh and other concerns, should be thinned with about 1 qt. naphtha to 1 gal. of paint. Thinning to a consistency suitable for suction feed is not recommended since the paint invariably will run on a vertical surface. Most free-brushing wall paints will spray better if about 10 percent of the oil is poured off
RUBBER BASE	Rubber-base paints spray beautifully with a minimum of dusting, but tend to clog internal-mix guns. Proper spray equipment is pressure feed, external mix. If sprayed with pressure feed, internal mix, use maximum fluid flow and keep a toothbrush handy for cleaning air cap of gun
SHELLAC	Reduce normal 4-lb. cut with 4 parts shellac to 3 parts alcohol. Spray pressure or suction. Shellac picks up moisture from the air and should not be sprayed in warm, humid weather
STAIN	All types can be sprayed suction or pressure feed. Best work (furniture) can be done with a suction gun. NGR (non-grain-raising) is preferred type for spraying schedules
SYNTHETICS	Most clear synthetics can be sprayed with either suction or pressure feed, although a few products can be sprayed pressure feed only. Practically all pigmented synthetics require pressure feed. Most products can be double-coated, that is, a medium first coat can be followed by a heavy second coat applied 15 min. to 1½ hrs. after the first coat
VARNISH	Quite often a synthetic product. Most clear kinds can be sprayed suction or pressure. Satins and flats are usually heavier and may require thinning. Avoid heavy coats
WATER-MIX WALL PAINT	Pressure feed only. To reduce dust, thin no more than needed (about 2 pts. water per gal. of paste). Use maximum fluid flow. Spray pattern, 8 to 12 in. Gun distance from work, about 8 in. Always flush gun with turpentine or lacquer thinner after cleaning with water to prevent rust

SPRAYERS



Here's the heavy field sprayer being pulled by a jeep and spraying plants in rows with the row-crop spray boom. Eight nozzles cover both sides of the plants. Other types of spray booms can be adapted to this unit

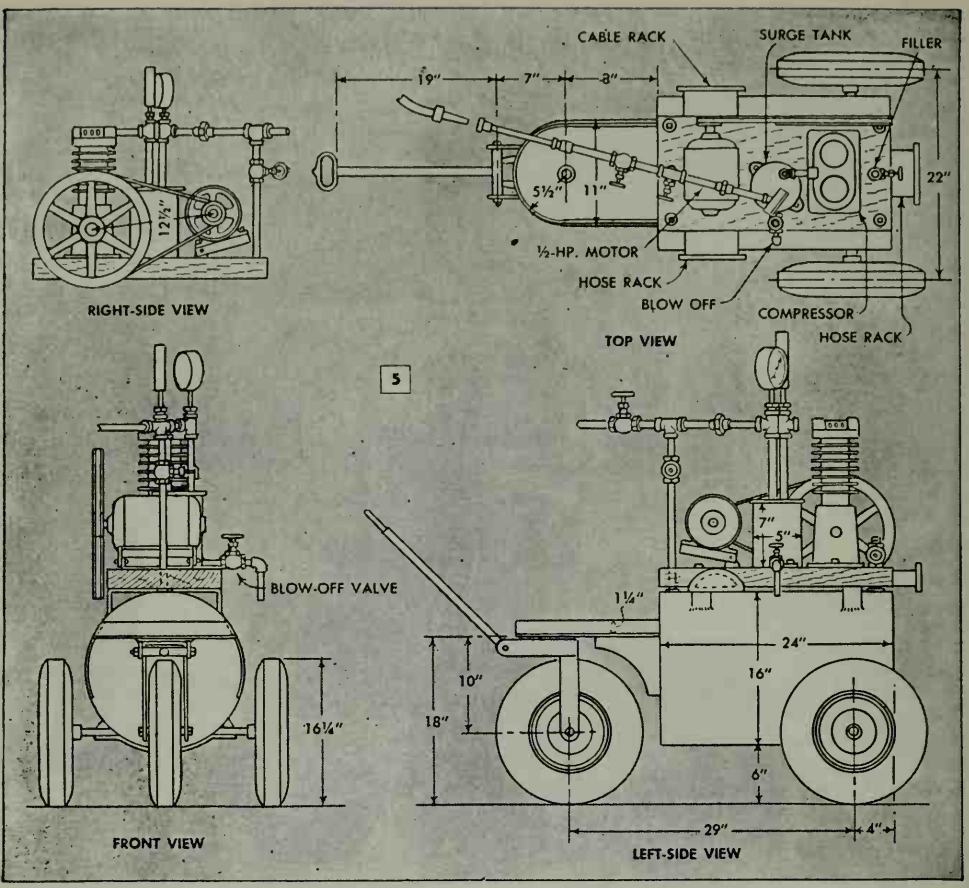




WITH THE EXCEPTION of such standard equipment as an electric motor, an engine, pumps, and, in one case, the tank, both of these handy power sprayers were built entirely in small farm shops. Each has been in service for more than two years. The electrically driven outfit shown in Fig. 3 was developed primarily for use in spraying insecticides in poultry houses, but has since been adapted to such varied jobs as spraying fruit trees and garden crops, spray painting and inflating tires. It is easily pulled about by hand, being mounted on a tricycle truck with large pneumatic-tired wheels.

Many of the parts can be assembled from materials you have at hand as slight variations in the specifications given for certain parts will not affect efficient operation. As an example, the pressure tank is made from a length of 16-in. steel well casing. Of course, a tank made from lighter-gauge metal would be just as suitable. The power unit is mounted on a plank bolted to the top of the tank, which forms the chassis. Arrangement of the various parts is shown in Figs. 2 and 3. The steel platform just above the front wheel holds a paint pail, spray gun, hose or other accessory. General dimensions of the unit are given in Fig. 5.

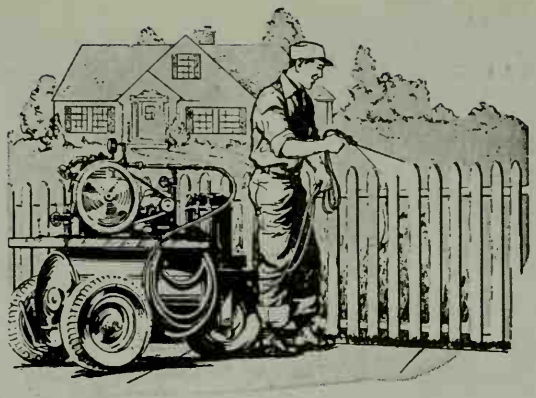
The tank, Fig. 4, is the first part to build. It is fitted with a



½ or ¾-in. reinforcing rod that passes through the center and through steel disks, which are welded in the ends of the casing section that forms the body of the tank. This reinforcing rod is necessary to give sufficient strength, with a reasonable margin of safety, to withstand the high pressures developed. Next, weld on the front platform, which is simply a piece of sheet steel with one end cut on a 5½-in. radius and a rim and supporting brackets welded to it. A hole for the kingbolt and one for an oilhole are drilled after the platform is welded in place on the tank. The stub axles for the rear wheels, Fig. 2, are welded to the tank and are reinforced with braces and a semicircular strap which passes under the tank and is welded there. After the front-wheel fork has been bent to shape, a 6-in. steel disk is welded to its top and two arms cut from flat iron are welded to the side members to complete the assembly. The handle is cut from ½-in. pipe with a ring welded to one end for a convenient handhold. A pipe sleeve is welded to the other end of the handle to fit between the arms on the wheel fork, as shown in Fig. 2 and the top view, Fig. 5. Finally, drill holes in the tank for a filler tube, air supply and an outlet at the back near the bottom. Standard couplings are welded into the latter two holes.

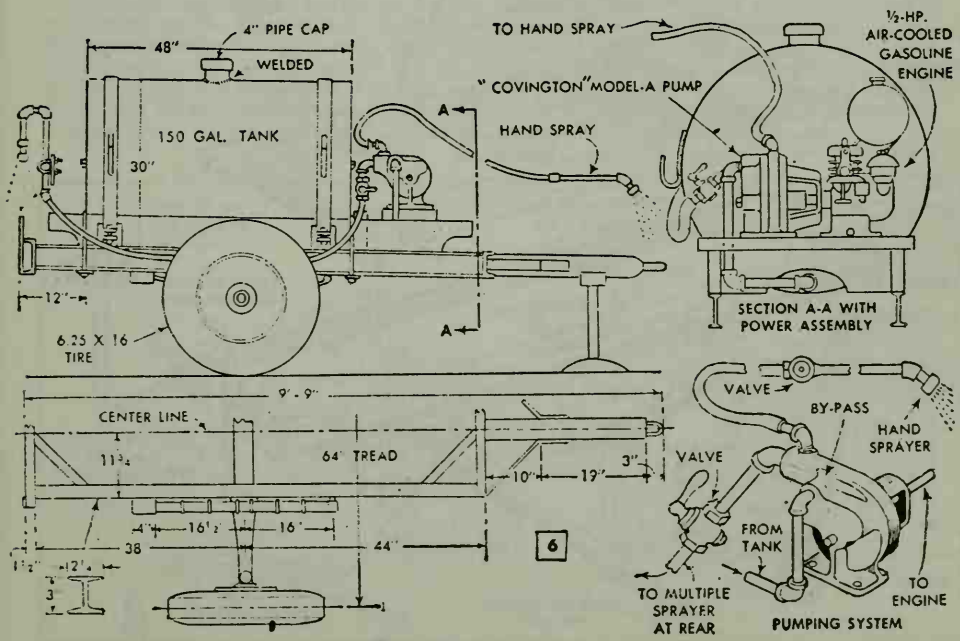
The power plant should be assembled on the base before it is bolted to the tank. Note that the motor is mounted on a hinged base to maintain uniform belt tension. Use a 2-in. drive pulley on the motor and a 12-in. pulley on the compressor and drive with a standard ½-in. V-belt. Employ at ½-hp. 1750-r.p.m. motor, and a standard two-cylinder compressor. Air from the compressor passes into a surge chamber which cushions the impulses when using a paint spray gun or insecticide equipment. The surge chamber is made from a length of 5-in. pipe capped at

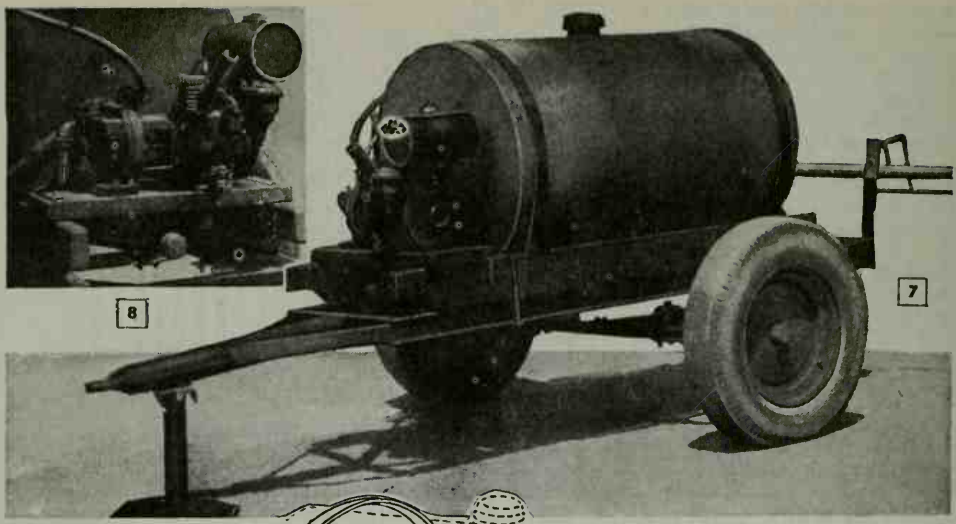
both ends and fitted with a valve at the bottom for blowing off condensation. Two bolt lugs are welded to the lower end. A pressure gauge is installed in the inlet pipe to the chamber and a poppet valve in the outlet pipe. When spraying insecticide, the valve is opened and air from the compressor passes directly into the tank, the liquid being discharged through a hose connected to the tank outlet. Wooden racks are fastened to the plank on both sides with lag screws to provide handy storage space for the motor cord and hose. Use industrial wheels with ball or roller-bearing hubs and 4.00 x 8-in. pneumatic tires.



Electrically driven sprayer is fitted out as an all-around unit. It handles any ordinary sprayable liquid from insecticide to paint

The pump-type sprayer detailed in Figs. 6 to 11 inclusive and also shown in Fig. 1 is designed for spraying row crops in large fields. The tank has a capacity of 150 gals. of liquid spray solution and the engine and pump are mounted in front of the tank. Outlets from the pump provide for a hand nozzle attachment for weed killing, Fig. 10, and also for a pressure-hose connection to a row-crop boom mounted at the rear of the chassis. The tank is of standard manufacture and it will prove good economy to purchase it outright rather than to attempt to make it in the average small shop. Side members of the chassis are steel I-beams, Fig. 9, and the drawbar is a length of 3-in. pipe with the outer end flattened over a heavy ring and welded. The axle was taken from a Star automobile, but a 1933 Ford or Chevrolet front axle will do as well. The steering knuckles are welded and the flat springs are used intact, except that the forward end of each is supported by a pin, without shackles, and the rear eye is cut





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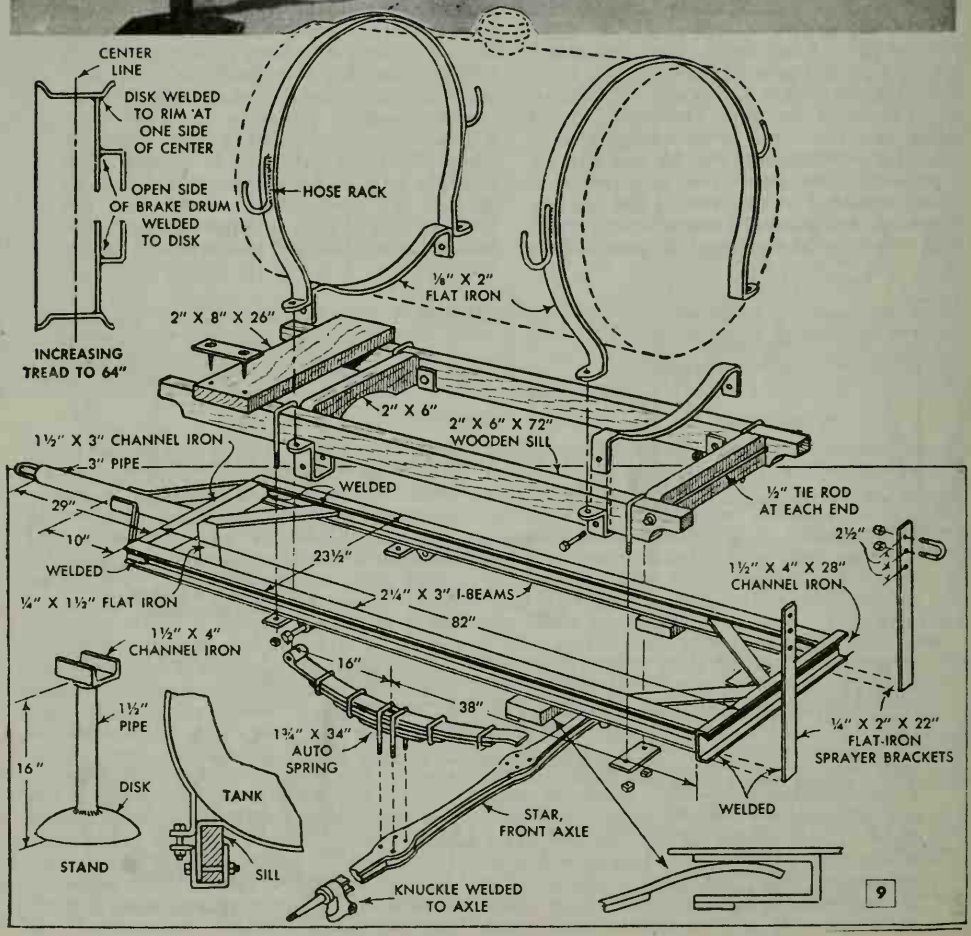
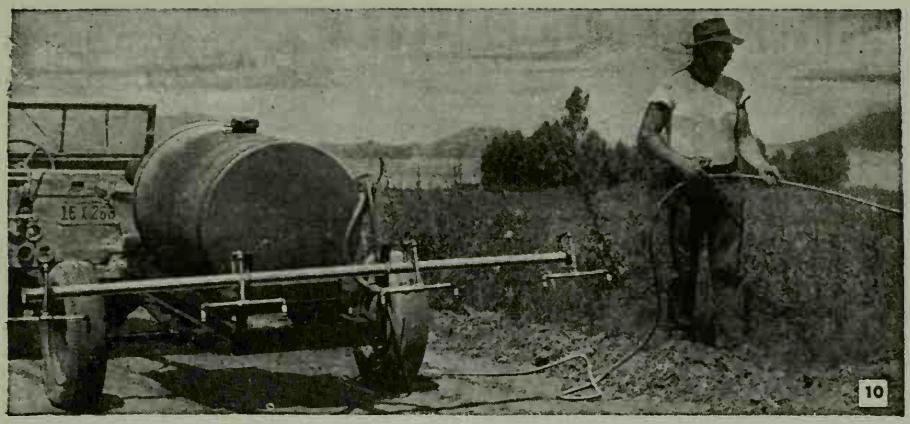

CENTER LINE
DISK WELDED TO RIM AT ONE SIDE OF CENTER
OPEN SIDE OF BRAKE DRUM WELDED TO DISK
INCREASING TREAD TO 64"
HOSE RACK
⅛" X 2" FLAT IRON
2" X 8" X 26"
2" X 6"
2" X 6" X 72" WOODEN SILL
1½" X 3" CHANNEL IRON
3" PIPE
WELDED
½" TIE ROD AT EACH END
29"
10"
23½"
2½"
WELDED
1½" X 4" X 28" CHANNEL IRON
¼" X 1½" FLAT IRON
2¼" X 3" I-BEAMS
82"
1½" X 4" CHANNEL IRON
16"
38"
1½" PIPE
1¾" X 34" AUTO SPRING
¼" X 2" X 22" FLAT-IRON SPRAYER BRACKETS
16"
DISK
TANK
WELDED
STAR, FRONT AXLE
STAND
SILL
KNUCKLE WELDED TO AXLE

9



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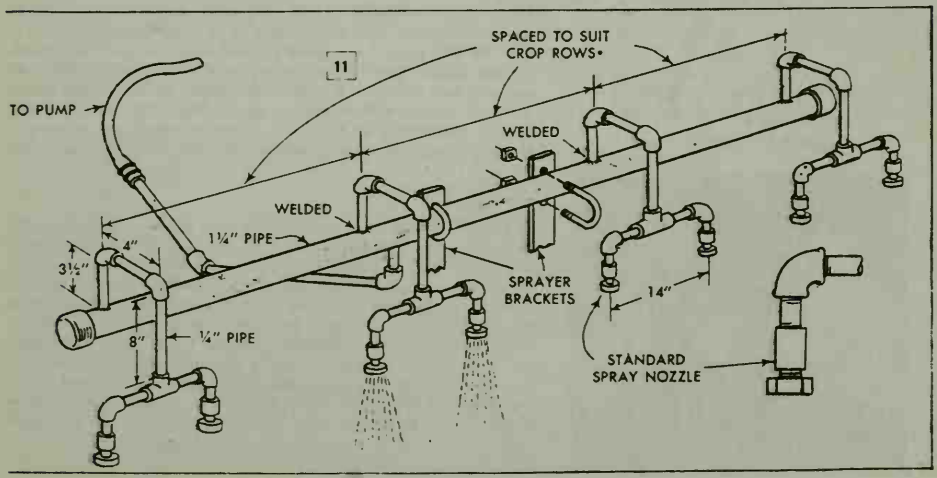
off and that end then rides in a box made by welding steel plates to the I-beam, as in Fig. 9. At the rear end of the chassis, two uprights are welded, each having a row of equally spaced holes to provide adjustment for the U-bolts holding the boom. A simple jack for supporting the drawbar is detailed in Fig. 9.

To widen the wheel tread sufficiently for average row-crop work, the wheels are altered, as in Fig. 9, by welding a standard wheel disk to the rim in an off-center position. A brake drum welded to the disk with the open side against the disk completes the change.

Fig. 9 also details the hardwood frame of the tank cradle. The sills are attached to the chassis with heavy U-bolts and the engine and pump are bolted to a heavy hardwood plank which extends across the front ends of the cradle frame. The plank is lag-screwed to the sills. Heavy tie rods pass through the sills just outside each spreader member. Two-piece steel bands, or straps, bolted to S-brackets attached to the sills support the tank and prevent it from shifting when the trailer passes over rough ground. Hooks welded to the bands on each side provide racks for hose storage. A common type of row-crop boom with two nozzles above each crop row is detailed in Fig. 11. It is built from standard pipe and fittings and standard spray nozzles. When assembling, use pipe-thread compound in all joints and draw each joint tightly to prevent leakage under pressure. Some users, such as potato growers, require three nozzles to each crop row. In this type of boom, two nozzles are aimed upward and the third nozzle is aimed downward. While this type of spray boom could, of course, be made from pipe and fittings, it is a good investment to purchase the three-nozzle boom ready-made.



Staining

IS EASY WITH BRUSH or SPRAY

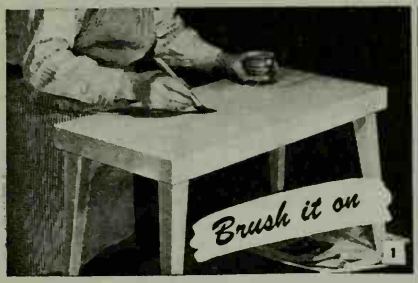
WATER STAIN is the least expensive stain and best for color clarity and permanence. It has a bad fault, however, in that the water solvent raises the wood grain, which must then be resanded smooth. An ounce of the dry stain powder added to hot water (just off the boil) will make a quart of stain. Add more water for a lighter tone. Keeps indefinitely. Apply with brush or spray, wipe to even tone. Let dry overnight before recoating. Available in all wood tones as well as straight colors

PIGMENT OIL STAIN is really thin paint. Instead of using a soluble dye stain, it is colored with a paint pigment. A good pigment stain can be made by thinning any paint or enamel with turpentine. Ready-mixed can be purchased in any paint store; usually indicated by the terms, "oil stain" and "wood stain," sometimes "pigment wiping stain" or "uniforming stain." Colors are permanent, do not bleed. Easy to apply with brush-on, wipe-off techniques. Dries in 20 min. to 8 hrs.

SOLUBLE OIL STAIN can be had in powder form for mixing with any light oil, such as benzol, turpentine, naphtha, etc. A small amount of asphaltum or 4-hr. varnish can be added for body. This stain has great penetration power; often is sold as "penetrating stain." It is not as light-fast as water stain. Colors tend to bleed into varnish and it must be sealed with shellac wash coat. Simply brush it on, wipe off. Requires an overnight dry. Can be purchased ready-mixed in popular colors

NON-GRAIN-RAISING STAIN uses same permanent dyes found in water stains, but the solvent is a nonaqueous liquid. It has all the good features of water stain without the grain-raising fault. You can mix your own with stain powder and solvent, but the cost is about the same as the ready-mixed product. Apply with brush or spray. Takes 10 min. to 2 hrs. to dry, depending on type. Ready-mixed colors are numerous. Concentrated primaries available for mixing your own tints

SHADING STAIN is a very fast-drying finish and is intended for application with spray gun only. The solvent is either alcohol or lacquer thinner, to which is added alcohol-solvent or lacquer-solvent dry-powder at the rate of 1 oz. per qt. A small amount of white shellac can be added to an alcohol stain for body; clear lacquer is added to a stain made with lacquer thinner. Shading stain dries ready for a following coat in 1 min. Usually applied between top coats. Shading stains are available ready-mixed in stock brown and red colors which are suitable for most work. This type of fast-drying stain is popular for shaded work because it dries fast. However, other stains are practical for this work



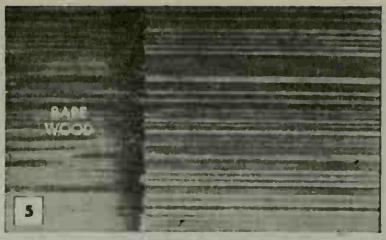
PIGMENT STAIN can be used for brown or blond tones—job shown is blond (beachwood) finish on maple. Pigment stain is brushed on, wiped off after a 5-min. dry with a soft cloth

STAINING in wood finishing as practiced today is largely confined to just two kinds of stain—pigmented with NGR (non-grain-raising). With this pair, you can do any job of wood staining easily and quickly. NGR is tops for all open-grain woods, while the pigmented oil stains are excellent for soft woods and also certain close-grain hardwoods such as maple and birch.

How to use pigmented stain: Be sure your work is well sanded with the final sanding no coarser than 3/0 garnet. After sanding and dusting, apply the stain with rag or brush, as shown in Fig. 1. You don't have to be careful or fancy—just get it on. Let dry 5 to 10 min. or until the stain starts to flat, then wipe with a soft cloth, with the grain, as shown in Fig. 2. Normally you remove all the stain that will come off with moderate wiping; you don't baby it or try to shade it. The result will be a color much lighter than the stain itself; the wood will have a new color without appearing painted. Let the stain dry a couple hours and then top it with shellac, lacquer or varnish.

Blonding: Since pigment stain is actually thin paint, it permits blond effects not possible with other

ADD OIL COLOR to white-pigment wiping stain to make any desired color. The oil color is mixed separately with turpentine and added to the stain as needed for the desired tone



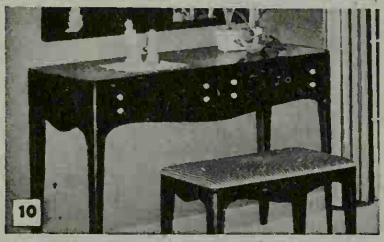
SAGE-GREEN COMBED FIR is a color effect that is worked on combed fir plywood with the use of pigment stain. Give the wark a priming coat af plywood sealer. Dry 3 hrs. and steel-wool lightly with 2/0. Dust. Then, to white wiping stain add a small amount of chrome-green oil color to the desirable shade. Brush the stain on the wood, let stand about 5 min. and wipe off with a soft cloth, working with the grain. Stain remains at full intensity in grooves. Let dry 2 hrs. Apply a coat af white shellac, clear lacquer or varnish. If desired, the work can be steel-wooled and highly waxed

PRISCILLA MAPLE is finished in the reddish-brown tone typical of Early American furniture. Stain the bare wood with Priscilla-maple wiping stain. Let stand a few minutes and then wipe clean. Dry 30 min. Apply a coat of sanding sealer or 2-lb.-cut white shellac. Dry 1 hr. Sand with 6/0 garnet. Put on a second coat af stain. Wipe it clean for highlights, leaving a heavier deposit an edges, moldings, etc., to obtain a time-worn effect. Dry 30 min. Brush or spray coat of rubbing and polishing varnish. Dry 24-36 hrs. Rub down to desired finish with any good commercial rubbing compound

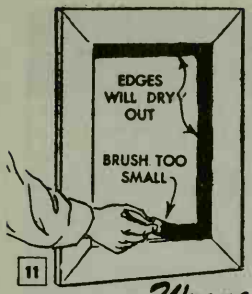
EBONIZED OAK is an attractive black finish with white pores. The best effect is obtained on plain-groin wood. Sand the wood very smaath, finishing with 6/0 garnet. Spray a coat of thin lacquer on the wood, applying just enough to get a solid black. If you are brushing, use a very thin black enamel or black shellac. When dry, apply a white paste wood filler. Let the filler flat and then wipe off clean with hair or moss. Dry 2 to 24 hrs. as required for filler you use. Top with water-white varnish (a dark varnish will discolor the white in pores). You can rub and polish to a high gloss if desired

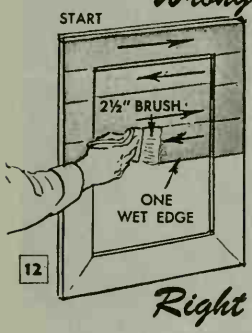
CHAMPAGNE MAPLE is a light pinkish-amber which is classified as blond. Buy the pigment wiping stain ready-mixed or make your own by adding a little brown and red oil color to white oil stain. Apply the stain and wipe off clean. Spray a coat af water-white sanding sealer. Sand with 6/0 garnet. Spray two coats of water-white lacquer. Rub with No. 280 wet-or-dry abrasive paper with soapy-water lubricant. Wipe aff and continue rubbing with 3/0 steel wool. Wipe off clean and apply a coat af paste wax. For brushing, use a 2-lb.-cut white shellac over the stain and top with varnish

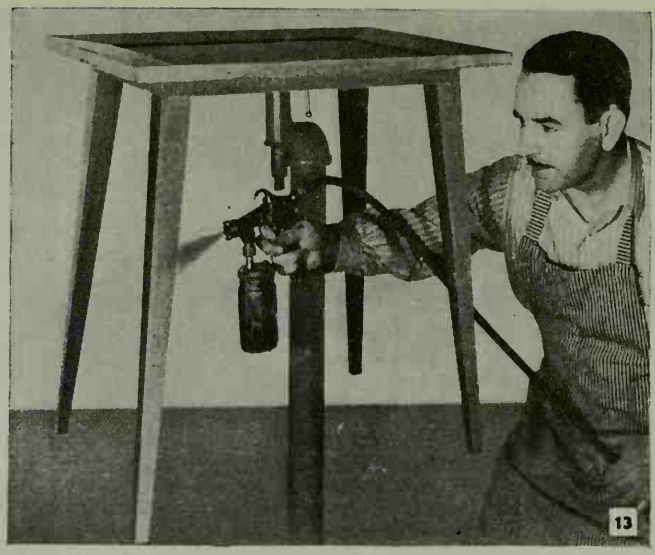
DOVE-GRAY WALNUT is a bleached finish. Start by applying a two-solution commercial bleach to the wood. Let dry 12 hrs. Sand lightly with 6/0 garnet. Apply off-white or light-gray pigment wiping stain. Wipe off clean. Let dry 30 min. and apply a second coat of stain. Wipe off clean, shading very lightly. Dry 30 min. and then apply sanding sealer. Let dry 1 hr. and then sand lightly with 6/0 garnet. Finish with clear lacquer or pale rubbing and polishing varnish. (Note: this is an apen-pore finish. If you want a level finish, substitute a gray filler for the first coat af the pigment stain)



CORDOVAN MAHOGANY is a deep, transparent red-purple finish. Use NGR stain of desired color on bare wood. Let dry 30 min. Fill with mahogany filler (this is nearly black) and wipe off with moss or burlap when it starts to flat. Put on a coat of sanding sealer; sand with 6/0 garnet; top coat with lacquer or rubbing and polishing varnish. Being dark, this finish needs a high polish to look well. Use wet-or-dry paper or rubbing compound to get a satin finish and then polish with palishing oil or very fine rubbing compound. French polish can be used to get a very high gloss after rubbing







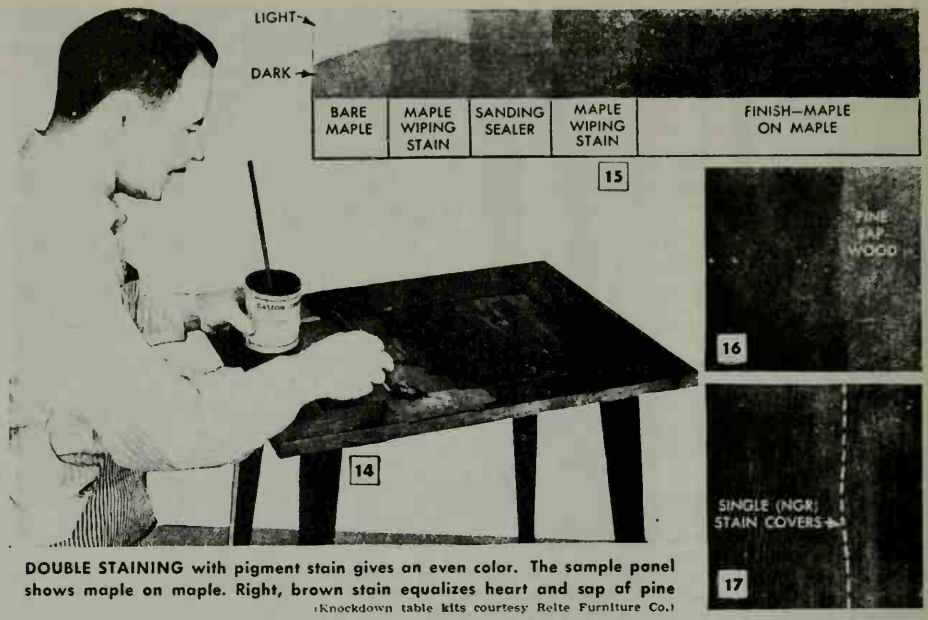
NGR STAIN is ideal for all open-grain woods. Stain dries quickly and is best sprayed with a suction-feed gun. Smooth brushwork without laps can be had with a 2 or 3-in. brush, applying stain fast and then wiping it evenly

stains. Clean wiping should be the rule, and this automatically limits the color range to moderate lightening of the original wood color. Don't try to make a blond out of black walnut. On naturally light woods such as maple and birch, a true blond is easily obtained with white-pigment wiping stain. Fir plywood, being a little darker, blonds best with an off-white or light-gray stain, such as ready-mixed Beachwood stain. Fir and other hard-soft grain woods will take a more uniform color if the grain is equalized with a primer coat of clear plywood sealer. Fig. 4 shows Beachwood stain on fir applied over a sealer coat; note how the wild grain of the wood is subdued. Interesting color effects can be obtained by toning white-pigment wiping stain with a little oil color, mixing this separately with turpentine, Fig. 3, and then adding to the stain until the desired color is obtained. Always make a test panel; remember the wiped stain is not nearly as strong as the stain itself.

Standard finishes: Six standard finishes using pigment and NGR stain are given on the opposite page. Learn these and you will know just about everything there is to wood finishing; with a change in stain and filler color you can produce any kind of finish.

Using NGR stain: Buy this from your craft supply house in popular wood colors. Be sure to order the special solvent needed. By far the best method of application is with a spray gun. Most NGR stains are formulated for fast drying, some being ready to recoat in 10 min. If you intend to brush the stain, be sure to get a brushing-or-spraying grade. Most NGR stains can be slowed down a bit with the addition of about 10 percent Carbitol or Cellusolve. Even so, the stain surface-dries very rapidly. An even color is most readily obtained by using a large brush and applying the stain in a very wet coat. Fig. 11 shows how *not* to do it. The cutting-in technique with a small brush is perfect for varnish top coats, but with NGR stain the edges will be dry before you get over the surface. On a small table top like this, the best system is to start at the top-left corner and with a wet brush carry the stain from side to side, including the edges. Then, wipe immediately with a soft rag to even the color and pick up excess. The whole trick is to get the stain on fast and wet—then wipe immediately. Always break the job into convenient areas; do legs, rails and top of a table in separate operations. If you doubt your ability to do a lap-free job, dilute the stain to half-strength with an equal amount of solvent. Apply two coats of this weak stain. Another way is to wash the work quickly with the stain solvent and then apply full-strength stain immediately.

If you spray NGR stain, apply in a moderate coat, not too wet. Shoot all inside edges first, Fig. 13. Do the top last. Use a small spray pattern but fan it out by hold-



DOUBLE STAINING with pigment stain gives an even color. The sample panel shows maple on maple. Right, brown stain equalizes heart and sap of pine (Knockdown table kits courtesy Relte Furniture Co.)

ing the gun a fair distance from the work. Always have a good light on the work so that you can properly evaluate color density. By spraying heavier on light wood and less on dark wood, it is easy to obtain a uniform color on mixed or off-color wood.

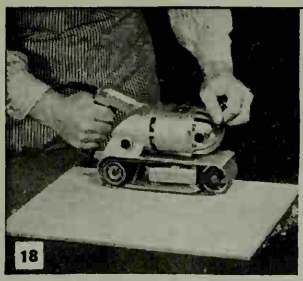
Double staining: An excellent method of obtaining an even, mellow color is to apply a double stain coat. This can be worked with either NGR or pigment, or the two mixed. Fig. 14 shows double staining with pigment stain using two successive coats, the first coat being allowed to set up and dry before applying the second. Fig. 15 panel shows maple double-stained with a coat of sanding sealer between the stain coats. This is the preferred method since it does not darken the wood as much and also gives a smooth surface on which to shade the second coat. Wipe the first stain coat perfectly clean; shade the second coat a little, leaving edges dark. Alternately, you can wipe both coats clean. The double stain coat helps wonderfully to obtain an even blend of sap and heartwood, Fig. 15.

Sap staining: Most jobs will have sapwood or other off-color areas which must be equalized. Test the wood first with a rag wet with water in order to determine how the stain will take. On pine and oak, light sapwood will usually drink a lot of stain and may become darker than the dark wood; on walnut the sap is usually dense and will remain light. If you use a moderate brown color on pine, the sap and heartwood will equalize under a single coat of NGR stain, as shown in Figs. 16 and 17. Pigment stain will take about the same way. If a test sample shows the sap too dark, a coat of thinned plywood sealer will equalize the grain structure. Sap in walnut should be painted out with diluted NGR stain following the first over-all stain coat before it is dry. Spot out dark mineral streaks with enamel matched to the stained color of the wood.

Job schedule: Photos on the opposite page picture a complete job schedule in finishing korina in brown mahogany. A double-staining technique is used with NGR mahogany stain for the ground color and mahogany-pigment wiping stain for the shade coat. With a change in stain colors and filler, the schedule applies equally well to any open-grain wood, any finish. Eliminating the filling operation, the schedule can be used for close-grain wood. Korina is light creamy-gray in color and makes an attractive blond finish when filled with natural paste filler on the bare wood.

Water stain: Many finishers like water stain because it is inexpensive. For best results, sand the work smooth with 4/0 garnet. Then, with brush or rag, apply a coat of plain water, not too wet. When this dries, sand lightly with fresh 4/0 paper to cut the "whiskers." Proceed with the water stain in the usual manner. The special solvent used in NGR stain can be added in any proportion to water stain; a blend of half and half is often used without preliminary water sponging.

Picture Schedule—MAHOGANY FINISH ON KORINA



SAND work before assembling, using 2/0 for belts, 3/0 for hand

DUST work thoroughly. A tack rag is useful in removing final traces

NGR STAIN is easily applied with a suction spray gun. Dry 30 min.

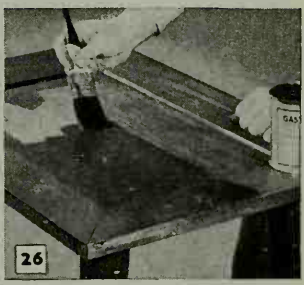
WASHCOAT of white shellac or clear lacquer over stain is optional

APPLY FILLER. This should be nearly black for a typical mahogany finish

WIPE FILLER across the grain with burlap and finish with the grain

SANDING SEALER can be sprayed or brushed; 2-lb. shellac is fitting

SAND the sealer with 6/0 garnet and blow off the dust. Use tack rag



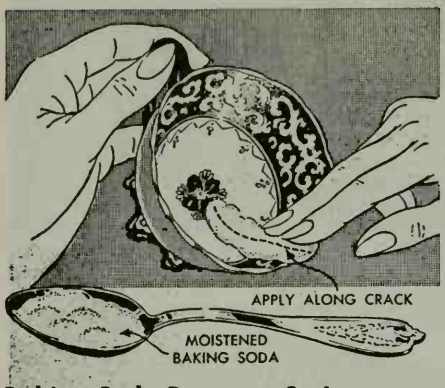
PIGMENT STAIN in a mahogany color can be brushed or sprayed

WIPE with cheesecloth, shading a little. Leave more stain at edges

TOP COAT can be lacquer or varnish. Let it dry thoroughly before rubbing

RUB with rubbing compound and burlap pad, using about 10 strokes

STAINS



Baking Soda Removes Stains On Rare China

Those who take pride in their collection of rare china will welcome this handy tip for removing tea and coffee stains from hairline cracks. First, apply ordinary baking soda, slightly moistened, to the area that is stained. Let stand for about one hour and wipe off. If one application does not remove the stain completely, repeat the treatment.

Lemon Rind Removes Mineral Stain

Instead of throwing away the skin after squeezing a lemon, use it with the adhering pulp to loosen mineral deposits from the insides of teapots or other kettles. Simply fill the utensil to be cleaned with lukewarm water, cut up and add the skin of one lemon to each pint of water and allow to soak for four or five hours. Then rinse the kettle with hot water.

Removing Stains From Fabrics

Treating Individual Stains

In cases where the nature of the stain is not known it should be first sponged with cold water, provided that the fabric is not injured by water. Try the action of the water on some inconspicuous part of the garment. Hot water should be avoided in treating unknown stains until after other substances have been tried, since it will set many stains and make their removal more difficult. If the stain is not removed by cold or warm water, chemicals should be applied.

Acids

With the exception of nitric acid, acids do not generally produce stains upon white fabrics but often even in dilute forms change or destroy the color of dyed materials. Most acids do, however, dissolve or weaken textile fibers, especially those from plants. Acid spots on textiles, therefore, should be removed at once by water or neutralized by some alkaline solution. Use one of the following:

Water. If the material is washable, rinse the spot several times in a large volume of water. This checks the action of the acid, but usually has no effect upon any discoloration due to it.

An Alkaline Substance. Apply a weak alkali to the acid spot. The alkali forms a salt with the acid, and this must be removed later by rinsing or sponging with water. The acid should be neutralized completely with the alkali or the discoloration may reappear after a while. To determine when the acid spot is completely neutralized, touch it with a piece of litmus paper, moistened with pure water. Litmus paper, which may be purchased at the drug store, is turned red by acids and blue by alkalis. If litmus paper is not available, touch the spot with the tongue. If alkaline, it will taste bitter; if acid, it will taste sour. Any of the following may be used to neutralize an acid spot:

Ammonia. If the spot is slight, neutralize it by holding it in the fumes from an open bottle of strong ammonia solution. This is a good method to use if the fabric water spots easily; otherwise the ammonia solution may be applied directly. However, some dyes are affected by ammonia. To guard against this, have dilute acetic acid or white vinegar convenient and apply it if there is an undesirable color change.

Sodium bicarbonate (baking soda). Sprinkle this on both sides of the stain, moisten with water, and allow to stand

until the acid is neutralized (at that point this effervescence will cease). Remove the excess by rinsing with water.

Ammonium carbonate. Apply in the same way as sodium bicarbonate or use a 10 percent solution.

Alkalis

Dilute alkalis have little effect on cotton and linen, but strong alkalis cause the fibers to swell and become yellow and the cloth to contract. Wool and silk, on the other hand, are yellowed or destroyed by alkalis even in dilute solutions. The color of any fabric may be changed or destroyed even though the fiber is not noticeably affected by the alkali. It is important, therefore, to neutralize alkali spots at once. Use any of the following agents:

Water. If the material is washable, rinse thoroughly with water. This is generally sufficient in the case of such alkalis as washing soda and ammonia.

A Mild Acid. Apply the acid with a cloth until the fabric changes back to its original color, or until the stain is slightly acid as shown by its reaction to litmus paper or by the taste. Then rinse the treated spot thoroughly in water. In the case of colored goods rub the spot dry, using a piece of the same material as the stained fabric, if possible. Use any of the following mild acids:

Lemon juice. Squeeze the juice on the stain. As long as the spot remains alkaline the juice is bright yellow in color, but when the spot becomes acid the color disappears almost entirely. Apply the lemon juice until this color change takes place.

Vinegar. If the vinegar leaves a spot, sponge with water.

Acetic acid. Apply a 10 percent solution of acetic acid to the stain and remove the excess by rinsing or sponging.

Blood

Hot water will set blood stains and therefore should never be applied until after treatment with cold or lukewarm water. Use one of the following agents:

Cold or Lukewarm Water. If the material is washable, soak the blood stains or rub them in the water until they turn light brown in color; that is, until most of the coloring matter is dissolved. Then wash the material in hot water. For stains on silk or wool, sponge with cold or lukewarm water.

Ammonia Solution. If the material is washable, soak in a solution containing about 1 ounce (2 tablespoons) of household ammonia to 1 gallon of water, until the stains are loosened. Then wash in the usual manner. For old stains ammonia is somewhat more satisfactory than soap.

Ultramarine Blue

The commercial blues which come in balls or blocks with directions to wrap them in a piece of flannel or other cloth and shake them about in the water to be blued are generally ultramarine. This is a finely divided, insoluble substance, which remains suspended in the water if it is stirred sufficiently but which settles on long standing. Use any of the following in removing stains caused by ultramarine blue:

Cold Water. Soak fresh stains or rinse them in an abundance of cold water.

Soap and Water. Wash the stains as in ordinary laundering, with an abundance of soap, and rub thoroughly. This treatment will remove stains which are not removed by soaking.

Dilute Acid. Hydrochloric acid, U.S.P., diluted with four times its volume of water; or acetic acid, 10 percent solution, will dissolve heavy stains of this kind. Rinse the material thoroughly after treatment with the acid.

Prussian Blue

The liquid bluing used commonly in the home laundry is in most cases a soluble variety of Prussian blue. It is greenish blue in color and soluble in water. To determine whether a bluing is of this kind, place a few drops in a glass, add a small quantity of a dilute solution of lye, potash, or washing soda, and warm by holding the glass in boiling water. A flaky, reddish-brown substance (ferric hydroxide) will form when Prussian blue is present.

Prussian or Chinese blue is sometimes the cause of yellow discolorations or spots upon white clothes. If the clothes are not rinsed free from strong soap, washing soda, or other alkali used in washing before they are blued with Prussian blue, the alkali remaining on the clothes reacts with the bluing and forms ferric hydroxide, which is deposited upon the clothes. This is set by subsequent drying and ironing, and is chemically identical with iron rust.

Clothes are occasionally overblued with

Prussian, as with other bluings, or may become streaked with the bluing if it has not been mixed evenly with the water. To overcome this condition the following treatment is recommended:

Cold Water. Rinse the stains in an abundance of cold water. This is effective only for very fresh stains.

Boiling Water. If cotton or linen, boil the material until the stains disappear. Excessive boiling, however, tends to yellow fabrics if there is soap or other alkaline substances present.

Chewing Gum

Water. If the material is washable, soften the gum stain with egg white and then wash.

Carbon Tetrachloride. Prolonged treatment with carbon tetrachloride is usually satisfactory, although it may be necessary to remove the traces of sugar by sponging with water. Treatment alternately with carbon tetrachloride and water is often effective.

Chocolate and Cocoa

Soap and Hot Water. If the material is washable, this is often all that is necessary.

Wood Alcohol and Ammonia. Soak the stained portion of the fabric in wood alcohol made alkaline with ammonia solution. This is a particularly effective method.

Grease Solvents. If the fabric is not washable, grease solvents will dissolve the fatty contents of the stain and the remainder can be removed by hydrogen peroxide.

Coffee

If the fabric is washable, use method 1 or 2; if not washable, use method 3.

1. Soap and Water. Fresh stains and most old ones on washable materials can be removed by ordinary laundering. A slight trace sometimes remains in the case of very heavy or old stains. Drying the material in the sun will frequently remove these.

2. Boiling Water. Pour boiling water on the stain from a height of 2 or 3 feet. This is effective upon stains which are not more than a few hours old.

3. Cold or Lukewarm Water. If the stains are on wool or silk material, sponge with cold or lukewarm water. If a grease spot from the cream remains after the spot has dried, remove it by the use of grease solvents.

Removing Coffee and Milk Stains From Clothing

To remove coffee and milk stains from clothing, proceed as follows: Make a solution consisting of glycerin, 1 part, ammonia, ½ part, and water, 9 parts. Apply it to the spot, using a small brush, and then immerse the stained part of the clothing in the solution for 8 to 10 hours.

Dyes and Running Colors

Water and Sunlight. If the material is washable, rinse the stains in cold or warm water, or soak them for 10 to 12 hours if necessary, and then dry in the sun. Repeat the treatment if the stains are not removed entirely the first time. Spots on woolen and silk materials sometimes may be removed by soaking or washing in cold water.

Egg

Sometimes a large part of the stain hardens on the surface of the material and may be scraped off with a blunt knife. Use cold water followed by one of these agents:

Hot Water and Soap. If the material is washable, use these as in ordinary laundering.

A Grease Solvent. Allow the stained place to dry after being sponged with cold water. Then apply the grease solvent.

Fly Paper (Sticky)

Carbon tetrachloride and benzol are particularly effective.

Fruits and Berries

Boiling Water. If the stain is on white or fast-colored washable material, stretch the stained material over a bowl or other vessel, hold it by a string or an elastic band, if necessary, and pour boiling water upon it from a teakettle held at a height of 3 or 4 feet, so that the water strikes the stain with some force. With some stains, especially those in which fruit pulp is present, a little rubbing alternated with applications of boiling water is helpful. A stain remaining after this treatment oftentimes can be bleached out by hanging the wet material in the sun to dry.

Lemon Juice and Sunlight. Stains remaining after treatment with boiling water can often be bleached by moistening with lemon juice and exposing to the bright sunlight.

Water and Hydrogen Peroxide. Fruit stains can be removed from white woolens if the cloth is soaked 10 to 15 min. in a quart of lukewarm soapsudsy water to which a tablespoon of hydrogen peroxide is added. Rinse in lukewarm water before drying.

Glue

Water. If the material is washable, soak the spot in warm water. Occasionally it is necessary to boil the stained material.

Acetic Acid. Sponge the spot with dilute acetic acid using absorbents such as clean blotters or a pad of soft cloth. White vinegar may be used instead of the acid but is not always so satisfactory.

Grass Stains

A method that is effective, is to use a small amount of ether. Saturate a small cloth wad and rub it over the stain.

Grease and Oils

Fresh grease spots may consist of the pure fat or oil. Old grease spots or stains from automobile, wheel, or machine greases, usually contain more or less dust, dirt, or fine particles of metal. Sometimes it is possible to scrape or wipe much of the adhering grease from a stained material. After this has been done there is a choice of three general methods of treating the stain itself. Wash it with soap and warm water to remove the grease; or absorb the grease with dry substances; or dissolve the grease in an organic liquid. Use one of the following agents:

1. Warm Water and Soap. Grease spots usually can be removed from washable materials with warm water and soap as in ordinary laundering if care is taken to rub the particular spot thoroughly. Soaps containing naphtha or kerosene are efficient.

2. Absorbents. Use blotting paper, fuller's earth, brown paper, French chalk, powdered magnesia, or white talcum powder for fine materials; corn meal or salt for carpets, rugs and other coarse materials. The use of absorbents generally is effective only on spots of grease or oil unmixed with particles of dirt or metal. The advantages of using them are that they do not wet the fabric or leave rings as often happens when water or grease solvents are employed.

3. Organic Solvents. Carbon tetrachloride, chloroform, ether, gasoline, naphtha, and benzol are effective in the removal of common grease and cedar and other vegetable oils. Carbon tetrachloride is best for removing cod-liver oil, although a bleaching agent may also be necessary if these stains are old.

Place a pad of clean cloth or a white blotter beneath the stain and change it as soon as it becomes soiled. Sponge the stain with a clean cloth, preferably a piece like the stained material, moistened with the solvent. To prevent the spreading of the grease and solvent, it is best to use small quantities of the solvent at a time and to work from the outside of the spot toward the center. It is well also to surround the stain with a ring of French chalk or other absorbent mentioned in method 2. After applying the solvent rub the spot with a clean cloth until it is thoroughly dry.

In removing grease spots which contain dirt or fine particles of metal, more rubbing and a larger quantity of solvent are necessary. It is best to apply the solvent from the wrong side of the material so that the particles will be washed mechanically from the fibers onto the pad or cloth placed underneath. If the spot does not yield to this treatment, immerse it in a small bowl of the solvent, and brush it gently with a small, soft brush. The brushing serves to loosen the insoluble particles, which then fall to the bottom of the bowl.

Generally, if the stained place must be dipped in the solvent, it is more satisfactory to immerse the whole article finally in clean solvent, which prevents the formation of rings. If sufficient solvent is not at hand for this, the ring usually can be removed by careful and patient sponging with small quantities of fresh solvent. Replace the cloth, pads, or blotter often as suggested above, and work from the wrong side of the material.

A paste made by mixing the solvent with French chalk, magnesia, or other white absorbent is often used. Spread the paste over the spot, leave it until thoroughly dry, and brush it off. Repeat this treatment if necessary. The spreading of the solvent and the formation of a ring will be avoided to a considerable extent in this way. The method is especially useful for cleaning light-colored unwashable materials, laces, and the like.

Emergency Grease Remover

When working about the car in good clothes, to make some minor adjustment on the engine, you may get a grease spot

on your sleeve. The soap compounds used by mechanics for washing grease off their hands, and which are usually kept around the garage, can be used to remove the stains. It is applied by means of a moist cloth and then washed off.

Ice Cream

Use one of the following:

Soap and Water. If the material is washable, use soap and water for stains in which no highly colored fruit or other substance is present.

Cold or Lukewarm Water. Sponge the stains thoroughly with water. If, on drying, a grease spot from the cream remains, remove it by the methods suggested for grease spots.

Indelible Pencil

Indelible-pencil stains can be removed from a garment with a sponge dampened in denatured alcohol; after sponging the stains for about 5 min., rinse the garment in cold soapsuds and then in several changes of clear water.

India Ink

If this has penetrated the fabric deeply it is impossible to remove completely. Wood or denatured alcohol, glacial acetic acid, chloroform, or gasoline (try in the order named) are helpful in dissolving the waterproofing ingredients and mechanically removing the carbon.

Printing Ink

1. Soap and Water. If the material is washable, fresh stains may be removed by applying an abundance of soap and water and rubbing thoroughly.

2. Lard. Rub the stained place with lard and work it well into the fibers. Follow with soap and water, as in method 1.

3. Turpentine. Soak for a few minutes in turpentine and then sponge out with chloroform, ether, or wood alcohol.

Writing Ink

For an ink spot of unknown composition, it is necessary to try various agents, beginning always with the simplest and that least likely to injure the fabric.

If the ink has been spilled on the carpet, first apply absorbents as in method 1. These are more satisfactory than the following methods which will remove the color from the carpet unless used very carefully. Try repeated applications of oxalic acid (method 4), or rub with the cut surface of a lemon, squeezing on the juice and rinsing between applications with a clean, wet cloth until no more ink can be removed. Rub the spot then with a clean, dry cloth. After the carpet is dry, brush up the nap with a stiff brush or a cloth. For ink stains on other fabrics, use one of the following:

1. Absorbents. To a moist stain apply corn meal, salt, French chalk, fuller's earth, magnesia, or talcum powder to remove any ink not absorbed by the fibers and to keep it from spreading. For a large ink spot, apply one of these substances before trying other agents. Work the absorbent around with a blunt instrument and renew it when it becomes soiled. When the dry absorbent fails to take up more ink, make it into a paste with water and apply again.

2. Soap and Water. If the fabric is washable, soap and water as in ordinary laundering is satisfactory for some types of ink.

3. Milk. Soak the stains for a day or two, if necessary, changing the milk as it becomes discolored. Pasteurized milk usually is not so satisfactory for this purpose as milk that has not been heated.

4. Oxalic Acid. Soak the stains for a few seconds in a saturated solution of oxalic acid, then rinse in clear water, and finally in water to which a few drops of concentrated ammonia solution have been added.

5. Potassium Acid Oxalate. Soak the stains for several hours, if necessary, in a solution of 2¼ teaspoons of potassium acid oxalate ("Salts of lemon" or "salts of sorrel") dissolved in one-half pint of water.

Iodine

Soap and Water. If the material is washable, soap and water will often remove a fresh stain.

Denatured or Wood Alcohol. Sponge the material. This agent can often be used on materials which water would injure.

Ammonia Solution. Sponge the stain with a dilute solution of ammonia.

Starch. Laundry starch dampened with water and applied liberally will remove iodine spots from most kinds of cloth.

Milk. Iodine stains can frequently be removed by soaking fabric in milk and occasionally rubbing the spot.

Iron Rust

Lemon Juice. Spread the stained place over a vessel of actively boiling water and then squeeze lemon juice on the stain. After a few minutes, rinse the fabric, and repeat the process. This method is rather slow, but does not injure delicate white cottons or linens.

Potassium Acid Oxalate. Immerse the stain in a solution of one-half teaspoon of potassium acid oxalate ("salts of lemon" or "salts of sorrel") to 1 pint of water. More crystals may be added if necessary. Boil until the stain disappears, and then rinse thoroughly.

Oxalic Acid. Prepare a saturated solution of oxalic acid. To prepare such a solution, dissolve as many of the crystals of the acid as possible in a pint of lukewarm water. Spread the fabric over a bowl of hot water and apply the solution to the stains, or put the crystals of the acid directly on the fabric and moisten with hot water. Rinse in hot water, and repeat until the stains disappear.

Meat Juice or Gravy

Stains from meat juice are similar to those from blood. Boiling water sets them and should not be used until the protein has been removed by cold water. If grease spots remain, they can be removed by the methods for "Grease and oils."

Medicines

If the nature of the medicine stain is not known, it is necessary to try various agents until one is found which serves the purpose. Each of the following agents is satisfactory in removing some medicine stains:

Boiling Water. Pour boiling water on the stain or launder washable fabrics.

Acids. Dilute solutions of hydrochloric or oxalic acid sometimes are useful for stains containing metallic salts.

Wood or Denatured Alcohol. Some stains can be sponged or soaked out with alcohol.

Mercurochrome. The bureau of standards states that fresh mercurochrome stains on silk can be removed by an application of benzaldehyde, allowing it to stand for a few minutes, repeating the application, and following it with a 25-percent solution of hydrochloric acid. Then sponge with alcohol and rinse freely in clean water. It has also been found that an application of glacial acetic acid to the fresh stains is fairly effective. If only partly effective, the spot should then be treated with ether. Only fresh mercurochrome stains can be removed.

Mildew

Soap and Water. If the fabric is washable, very fresh stains can be washed out with soap and water. Drying in the sun helps to bleach the spots.

Sour Milk. Soak the stains overnight in sour milk and then place in the sun without rinsing. Repeat the treatment several times if necessary. Slight stains can be removed in this way.

Lemon Juice. Moisten the stains with lemon juice and salt and allow them to remain in the sun. This often removed slight stains.

Milk and Cream

Cold or Lukewarm Water. If the material is washable, rinsing in cold or lukewarm water followed by hot water and soap is generally sufficient.

Grease Solvents. Use carbon tetrachlride, acetone, gasoline, or other grease solvent. For fabrics which ordinary laundering would injure, first sponge with the solvent, allow the spot to dry, and then sponge carefully with water.

Oil Paints

Before using any agent on paint or varnish stains, it is best to scrape off as much of the stain as possible from the surface of the material. If the stain has hardened, apply the solvent on both sides and give time for it to soften. Excessive rubbing roughens the fabric. Methods 1, 2 and 3 are for fresh stains. For those that have hardened but have not oxidized in the fiber, methods 4, 5 and 6 are more suitable.

1. Soap and Water. If the material is washable, fresh stains are removed easily by carefully washing with plenty of soap. Older stains sometimes can be removed in this way if first softened by rubbing oil, lard, or butter into them thoroughly.

2. Turpentine. Sponge the stains with pure turpentine or wash the whole article in it, if the spots are large or scattered. Rinse several times in fresh quantities of the solvent.

3. Turpentine and Ammonia. Stains which are not fresh and yet have not entirely hardened can be softened by moistening them with ammonia solution and

sprinkling them with a little turpentine. Roll the article up for 15 to 20 minutes, or soak it for several hours, if necessary, and then wash with warm water and soap.

4. Oil Solvents. Carbon tetrachloride, chloroform, or benzol, applied in the same way as turpentine, are satisfactory. Gasoline, kerosene, and alcohol are helpful but usually less effective.

5. Benzol and Acetone. Benzol and acetone used in equal parts make a very good paint remover. Equal parts of benzol, acetone, and alcohol also make an excellent solvent. Benzol is a good solvent for the usual type of spar varnish, and wood alcohol will remove stains of shellac varnish.

6. Sodium Carbonate (Washing Soda). Boil the stains in a solution containing 3 tablespoons of washing soda to 1 gallon of water. This is successful for such fabrics as will stand the treatment.

Paraffin or Paraffin Wax

Much of the stain usually may be scraped away. For removing the part of the paraffin stain which has penetrated the fiber, use one of the following agents:

Blotting Paper. Use blotting paper and a warm iron.

A Grease Solvent. If a trace of the stain remains after treatment with blotting paper, sponge the stain carefully with a solvent. (See "Grease and oils").

Perspiration

Perspiration stains on clothing should be soaked in a strong salt-water solution before the garment is laundered.

Scorch

Scorch on cotton and linen sometimes can be removed, if fibers are not actually burned. Wool and silk usually can not be restored to their original condition after being scorched, but wool may be improved by brushing with emery paper. For removing slight scorch stains from cotton and linen, use one of the following:

Soap and Water. If the fabric is washable, soap and water are sufficient to remove very slight stains.

Water and Sunlight. Wet the spot with water (or soap and water) and expose to the sun for a day, or longer if necessary. The scorch disappears more rapidly if the material is moistened first.

Hydrogen Peroxide. Light scorch stains can be removed from white fabric as follows: Dampen a white cotton cloth with hydrogen peroxide and place over stain. Place a clean dry cloth over this to protect the iron and then iron with a medium warm iron, replacing the top cloth if the hydrogen peroxide soaks through. Repeat the operation if necessary. Precautions: Do not iron directly on the cloth moistened with peroxide or on the moist fabric after the dry cloth has been removed. If this is done, the iron leaves rust stains on the garment.

Black Shoe Dressings

Soap and Water. If the material is washable, fresh stains made by one of the paste dressings can be removed by sponging or washing thoroughly with an abundance of soap.

Turpentine. Use only for the pastes containing turpentine. This may be detected by the odor. Immerse the stained places and rub gently in turpentine.

Tan Shoe Dressings

Use one of the following agents:

Soap and Water. Use for stains on cotton and linen.

Wood or Denatured Alcohol. The stains on wool are removed more successfully by sponging with alcohol than with soap and water.

Soot

Soot spots, being composed of fine particles of carbon, are insoluble and must be removed mechanically from a fabric. Use one of the following agents:

Absorbents. First brush the stain, then place on it such absorbent powders as fuller's earth, French chalk, cornstarch, corn meal, or salt. Work them around until they become soiled and brush them away. If the fabric is washable, then sponge or wash the stain with soap and water.

Organic Solvents. Chloroform, gasoline, or other organic solvents may be used to rinse the soot from materials injured by washing. First brush the stain lightly or treat it with absorbent powder, as in method 1, then immerse it in the solvent and rub gently, or brush with a small, soft brush.

Sugar

Sugar spots on silk or crepe dresses are difficult for the home cleaner to remove as gasoline will not dissolve them and water

leaves rings or destroys the color. To avoid these difficulties, cut down the bristles of a discarded toothbrush to approximately half their normal length. Stretch the spotted portion of the garment over the ironing board and brush across the grain of the fabric. The brushing will loosen and remove the sugar, if this is perfectly dry, and will also raise the nap so that the spot cannot be detected. Even though some of the sugar may remain in the fabric, it will not become apparent until the garment is dampened and pressed the next time.

Tar, Road Oil, Creosote, Oil, Asphalt, Asphalt Paint, Axle Grease

The stains from these substances are grouped together because they are somewhat similar in their chemical composition and certain solvents may be used for all. The stains are rather difficult to remove, especially from cotton. After the oily or tarry part has been taken out, dark-colored organic or mineral impurities are likely to remain. Use one of the following agents:

Carbon Tetrachloride. Sponge the stains with carbon tetrachloride or immerse them in the liquid and rub. The latter treatment is best if the fabric is not too delicate. Follow by a thorough washing in soap and water if the fabric is washable. For stains on carpet, scrub with a cloth soaked in the solvent, changing to a fresh cloth as soon as it becomes discolored, and continuing as long as any color comes off.

Carbon Disulphide. Caution. This is the best general solvent for these substances but it is very inflammable and poisonous. If used, it should be kept far away from any flame and the garment cleaned in a very well-ventilated place. It is better not to store the unused portions of the liquid.

Benzol, Chloroform, or Turpentine. These may be applied in the same way as carbon tetrachloride.

Lard. Rub thoroughly into the stain, then wash in hot water and soap. Repeat the treatment if necessary.

Water Spots

Some silks and wool are spotted by water. This probably dissolves a part of the finishing or weighting substances, and, when the water evaporates, they are deposited irregularly or in rings. A satisfactory method for removing such spots is to dampen the entire material evenly and press it while still damp. This may be done either by sponging the material carefully with clean water or by shaking it in the steam from a briskly boiling teakettle until it is thoroughly damp. Another method is to dip the garment in an organic solvent. Scratching with the finger nail or a stiff brush is sometimes sufficient.

Tomato Vine

Lemon Juice and Sunlight. First wash the stains carefully, then moisten them with lemon juice and expose them to the sun for several days if necessary. This is satisfactory for stains on white washable materials.

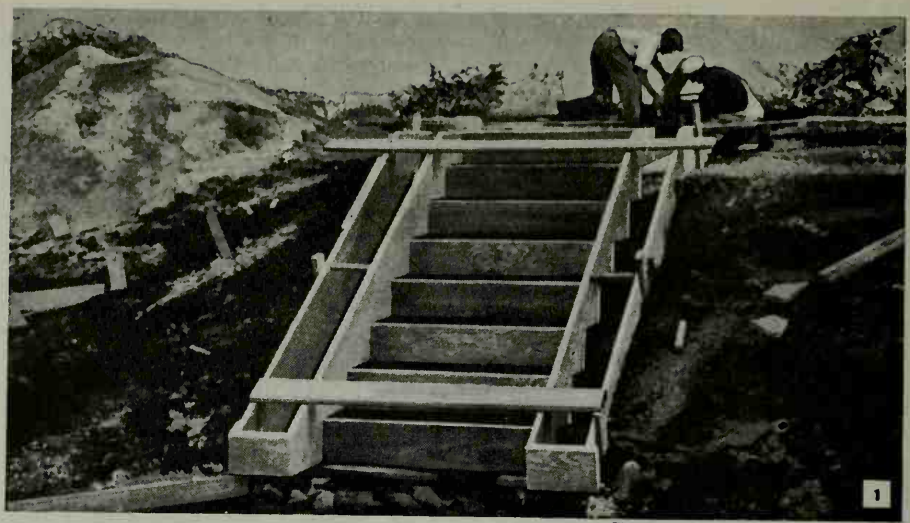
Non-Inflammable Cleaning Fluids

An excellent dry-cleaning fluid that combines the efficient grease-dissolving powers of naphtha and carbon tetrachloride is made by mixing carbon tetrachloride, 3 gal., deodorized cleaners' naphtha, 1¾ gal., benzol, 24 oz. and chloroform, 2 oz. A slightly less expensive cleaner of the same type that is suitable for most purposes, may be made by mixing carbon tetrachloride, 3⅛ gal., deodorized gasoline, (not Ethyl gasoline) 3 gal. and chloroform, 2 oz. Still another cleaner that is exceptionally quick acting and combines the detergent action of soap with the grease-dissolving ability of solvents is made by mixing diglycol oleate, 1 oz. and water, 1 oz. This mixture is then stirred into a solution of butyl cellosolve, 1 oz., isopropyl alcohol, 10 oz., and carbon tetrachloride, 14 ounces.

Evaporation of Cleaning Fluid Retarded With Tumbler

When using ether or chloroform to remove paint and varnish stains from garments having a delicate weave, the fluid usually evaporates so fast that the stains cannot be removed without vigorous rubbing, which is destructive to the fabric. The evaporation can be retarded by placing an inverted tumbler over the spot after applying the fluid. Allow sufficient time to permit effective chemical action before removing the glass, and then carefully sponge the spot to remove the stain.

Several recipes for cleaners and finishers reprinted from University of Illinois Circular 526. Part of information on removing stains reprinted from Farmers' Bulletin 1474 of the U. S. Department of Agriculture



Photos courtesy Portland Cement Association

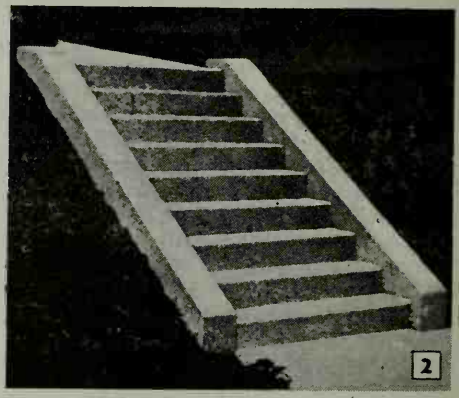
STAIR Building and Repair

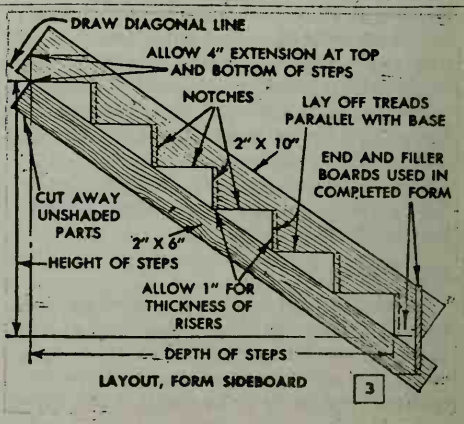
CONCRETE STEPS

CONCRETE-STEP building involves setting the forms, mixing and pouring the concrete.

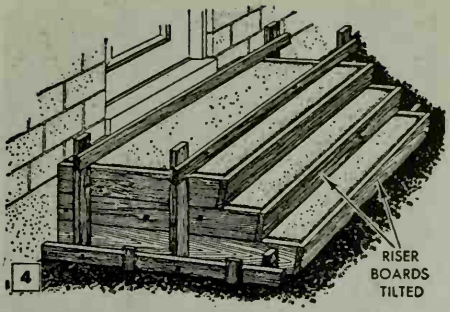
The first step in setting the forms is preparing the ground over which the steps are to be cast. If the soil is well-drained and contains gravel and sand in relatively small amounts, about all that is necessary is to level and tamp the area thoroughly to compact the soil. On the other hand, if the soil is a heavy, tight clay through which drainage of surface water is slow in wet seasons, it will be necessary to excavate to a depth of 6 to 8 in. below grade and put in a tamped-gravel fill. Thorough tamping of the fill is of the first importance. Make a tamper by cutting an 18-in. length from a 6 x 8-in. timber and nail a 36-in. strip to each side to provide handles. Go over the whole area of the gravel fill with the tamper several times in order to compact the fill uniformly. Cinders should never be used as a fill under a heavy concrete casting as they disintegrate in time.

Fig. 1 pictures the form required to produce the type of terrace steps shown

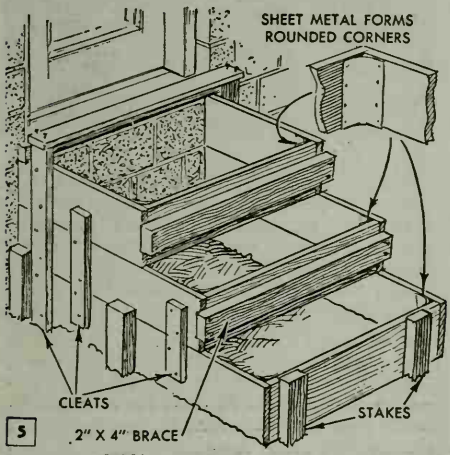




Only the simplest hand tools, such as hammer, saw and a good level, are needed for constructing the necessary forms used in building the concrete steps shown above



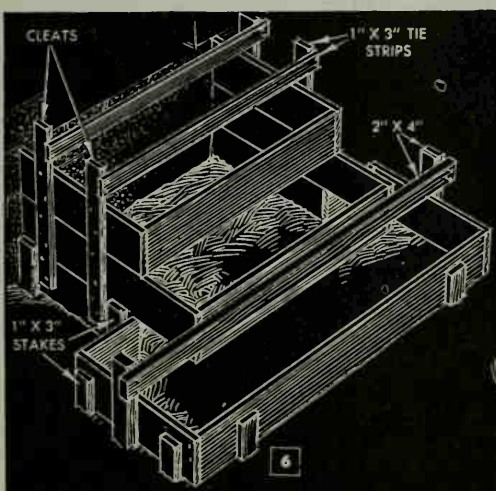
In this form, the riser boards are inclined at an angle of 5 deg. The purpose of this is to add to tread width without increasing the over-all dimensions

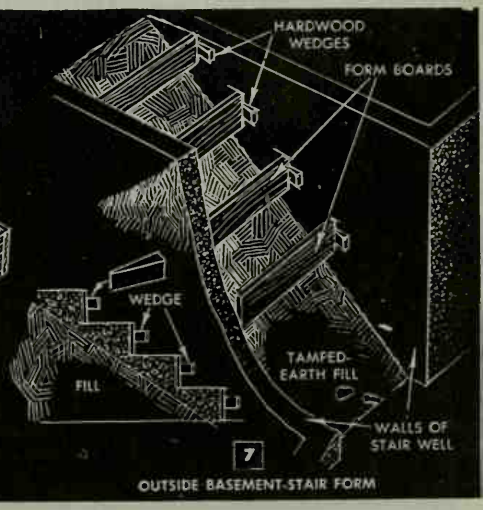


Braces, or stiffeners, usually are required to prevent springing of the riser boards under pressure of freshly poured concrete. Tie strips hold sides

in Fig. 2. Fig. 3 shows the method of laying out and cutting the form sideboards. Compare this with the simpler forms detailed in Figs. 4, 5 and 6. The form detailed in Fig. 6 gives the type of steps pictured in Fig. 8. To cover a given ground area, both types of forms require about the same amount of material per single step but the construction differs in some details. Note in Fig. 4 that the riser boards are inclined at an angle of about 5 deg. The purpose of this is to add to the actual tread width without increasing the over-all dimensions of the form. The inclination of the risers gives more toe room. In making this type of form, the risers should never be inclined more than 5 deg. The form in Fig. 4 is constructed for casting the steps, or stoop, considerably wider than the entrance doorframe. The smaller form in Fig. 5 has been made the width of the doorframe. In some types of stoops, this width may be necessary or desirable, but the general practice is to set the form to give a width that will extend from 6 to 18 in. on each side of the doorframe. This width allows plenty of room for installing an ornamental iron railing.

Lumber used for the forms should be smooth on one side and free from knotholes. In addition to adequate staking, the boards should be well supported with braces and stiffeners to prevent bending under pressure when the concrete is poured. This is especially important where the width of the steps makes it necessary to use long riser boards. Braces, or stiffeners, of 2 x 4-in. stock should be nailed across the outer faces of all ¾-in. riser boards more than 30 in. long and also across the face of 2-in. riser boards more

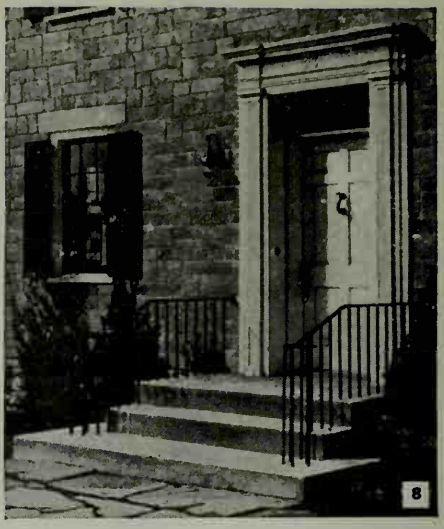




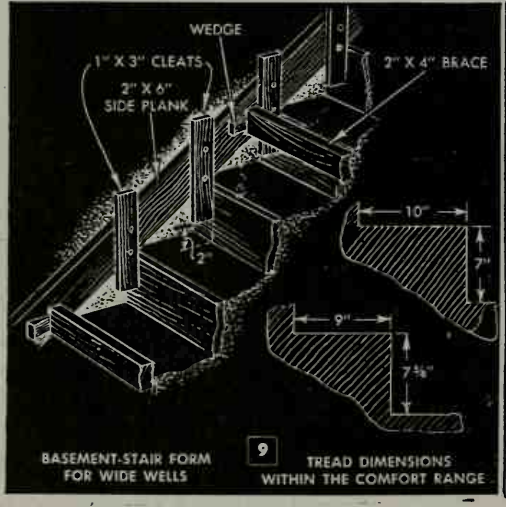
than 60 in. long. These braces or stiffeners, are shown in place in Figs. 5 and 6. When staking the first, or lower step form, use at least two stakes, Fig. 5, against the first riser board if it is 30 in. or less in length. If more, use three or four stakes. Tack the stakes to the board from the outside by driving the nails only part way in. The sideboards of forms like those in Figs. 5 and 6 are held together by means of cleats, at least two being required on each side, in addition to two or more stakes driven into the ground.

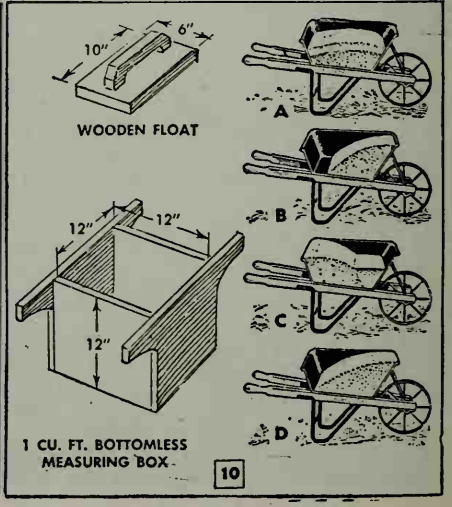
In Fig. 4, a somewhat different method of cleating and staking the sides of the form is shown. Here, the three sideboards are nailed to two 2 x 4-in. stakes previously located and driven at each side of the form. After plumbing the assembled sideboards, tie strips are nailed to the projecting ends of the stakes to keep the form from spreading under pressure of the freshly poured concrete. Then a narrow board is tacked to the stakes at each side of the form and additional short stakes are driven outside this board as shown. In this way, the end members of a wide form cannot shift during the pouring. The 2 x 4-in. braces, Fig. 5, have been omitted from the form in Fig. 4 to show better the angle of the riser boards.

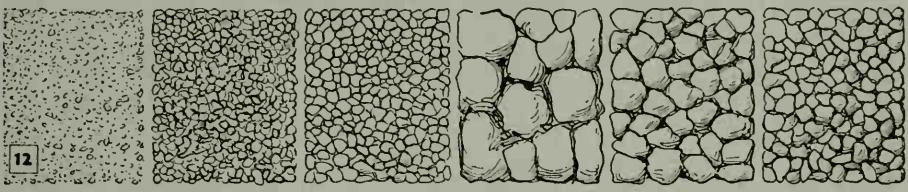
When concrete side walls are cast integrally with the steps, Figs. 1 and 2, each step is reinforced with a ½-in. steel reinforcing bar which is placed in the step as the concrete is poured. The bar should be cut to such length that it extends beyond the ends of the step a distance equal to about half the thickness of the side walls. These bars prevent the side walls from cracking away from the steps.



Figs. 7 and 9 detail methods of setting forms for basement stairs. Where the stair well is already formed with concrete walls, the stair forms are simply riser boards spaced, plumbed and wedged between the walls. The earth fill is tamped to a uniform slope. When the steps are wider than normal, it is necessary to fit side planks and vertical cleats so that the riser boards may be supported by horizontal braces which are wedged against the side planks, as in Fig. 9. Be careful in laying out and setting forms for basement stairs to keep the tread-to-riser proportions within the accepted comfort range, as in the right-hand details of Fig. 9. These dimensions





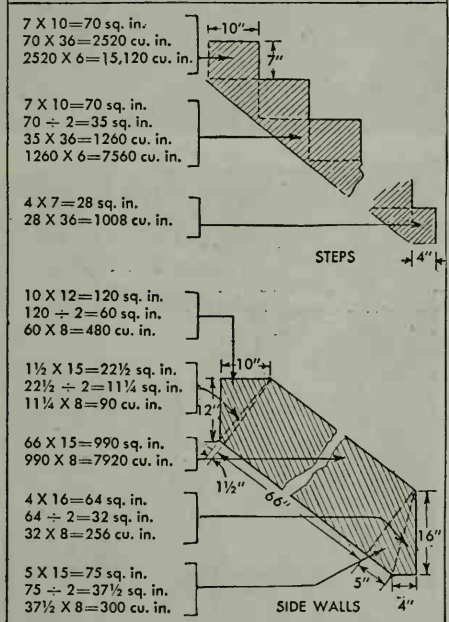


Clean, sharp sand of the quality used for concrete work should have fine, medium and large particles mixed in about equal proportions for the best results

The largest pebbles of the gravel should not exceed 1½ in. in size. Concrete mix should contain very nearly equal quantities of large, medium and fine pebbles

13 HOW TO FIGURE CUBIC VOLUME OF STEPS

Example: Six steps 36 in. wide, 7-in. riser and 10-in. tread, with 8-in. side walls.



15,120 cu. in.	
7,560 cu. in.	480 cu. in.
1,008 cu. in.	90 cu. in.
	7920 cu. in.
23,688 cu. in. Steps	256 cu. in.
18,092 cu. in. (9046 X 2)	300 cu. in.
41,780 cu. in. Volume	9046 cu. in. One side wall

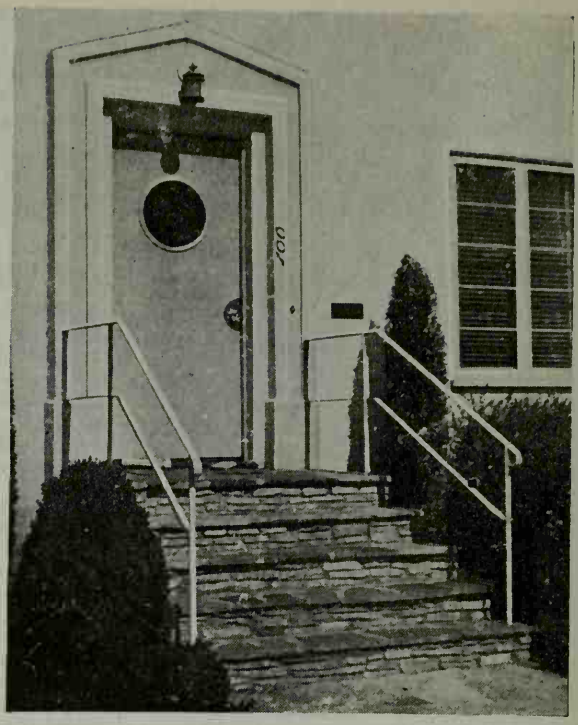
Total volume in cu. ins. 41,780 ÷ 1728 (cubic ins. per one cu. ft.)=24 cu. ft., approx.

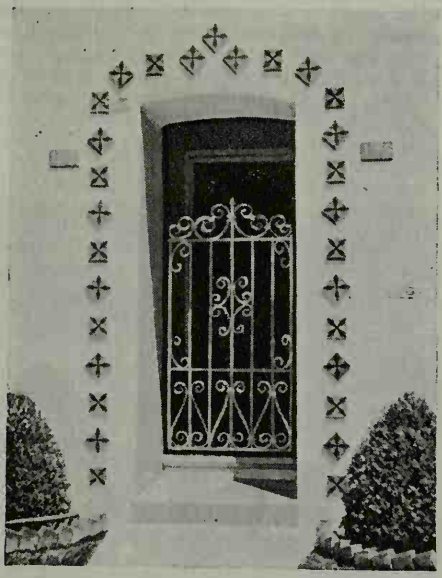
also apply when building forms for other types of steps.

On small jobs, concrete may be mixed by hand methods but, where several yards are required for a single pouring, it is better to rent a mixer or purchase concrete ready-mixed to specifications. In hand-mixing, make a bottomless box, Fig. 10, for measuring the amounts of gravel, sand and cement. The box holds 1 cu. ft. of dry material if made according to the dimensions. One good way of mixing is to shovel the measured materials into a wheelbarrow. Mix the dry materials as in steps A and B, Fig. 10. Add the proper amount of clean water, step C, and mix thoroughly, step D. Once the pouring is begun, continue until the job is finished. As soon as pouring is finished, level the concrete flush with the top of the forms with a wooden float, Fig. 10. Wait until the concrete stiffens slightly before troweling. Edges of the treads and other parts of the concrete work are rounded by running an edging tool along the top edges of the forms. Cover the concrete with wet sacks or straw and keep the covering damp for several days after pouring to aid in proper curing.

The largest size of gravel used in the concrete mix for pouring the average entrance steps should not exceed 2 in. in diameter, Fig. 11. Smaller average sizes are better. The average proportions of the sand and gravel sizes are shown in Fig. 12. The table, Fig. 13, shows how to estimate in detail the amount of concrete required for steps and side walls. If the aggregate (sand and gravel) is only slightly damp, use 5½ gal. of water per sack of cement when mixing. If the aggregate is quite wet, use only 4 to 4½ gal. of water per sack. Use of the correct amount of water is important.

Styled to the architecture of the home, front entrance ways, as well as the front steps, add to the final finishing detail in giving measurable values to any home. In selecting the type of door, whether it be for new construction or for use in remodeling an older home, careful consideration should be given to exposure, distance between windows on the same wall, size of windows and the height of the doorsill above grade. Recessing the door into the wall, as shown in the illustrations, helps to protect it from weathering. Where the door is framed on the wall line, a canopy may be constructed for the same recessed protection. Recessed doorways of colonial design are best suited to large homes of traditional architecture. Installation of hand-wrought hardware completes the period detail in the entrance way. New homes with low roof lines call for doorways of modified modern designs and construction.





Guarded by heavy ornamental-iron grille and framed by colored glazed tiles set in the masonry wall, this deeply recessed doorway is easily adapted to the modernized types of Spanish architecture. It appears at its best when installed at grade level

Plain straight lines of massive woodwork, flared side panels and an ornamental-iron pediment rail characterize this doorwoy. Note the similarity between it and a later type shown in photo at upper right. Both are suited to large two-story homes

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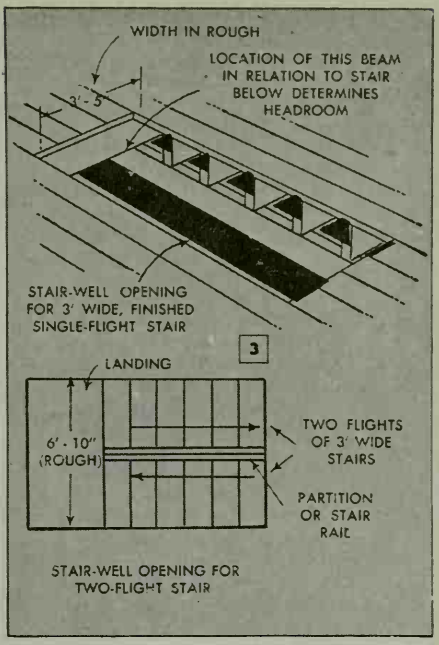
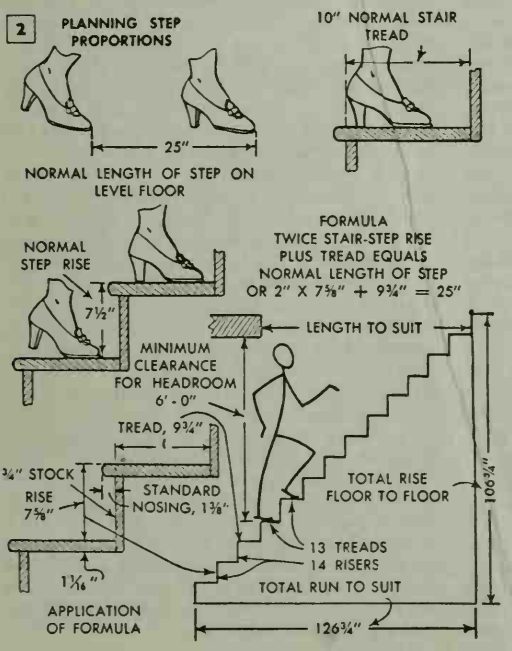


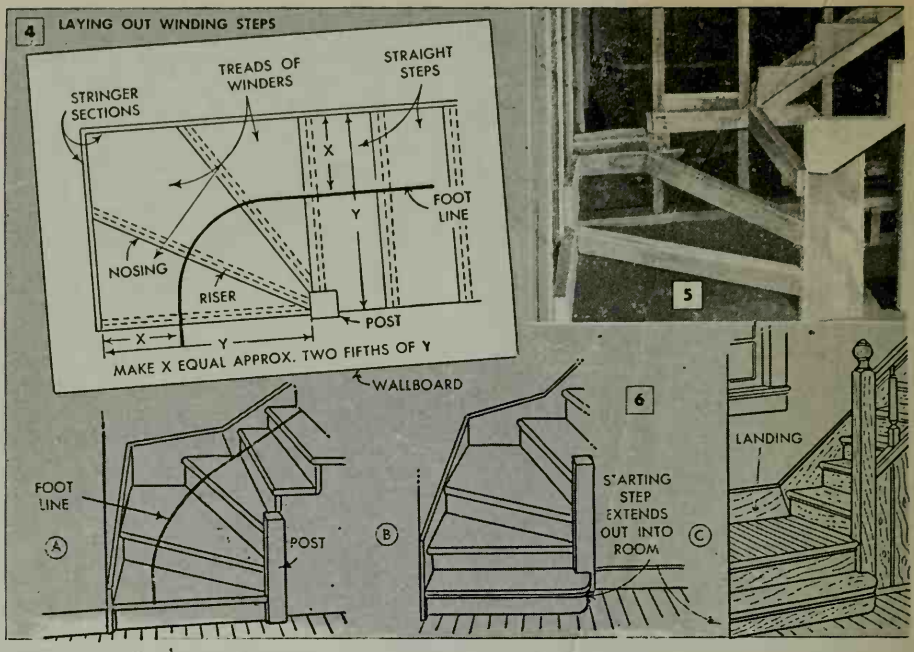
Above, stair rails of the type shown consist of a number of precut parts made from selected hardwoods. Below, layout of stair is based on normal length of step on a level floor



INTERIOR STAIR BUILDING

Installation of a safe, attractive stair in either old or new homes is one of the most important details in the interior construction. Welcome savings for the homeowner can be had by doing the job himself. Stairs that pitch too steeply, or those with abnormal treads and risers and insufficient headroom are a constant accident hazard. For safety, the stair must include all of the basic construction features detailed in Figs. 2 and 3. In the construction or remodeling of small and average-size homes in which stair space usually is limited, the two or three-directional, open-string stair with landings or winder treads often is best as it generally can be placed at the end of a room. In remodeling older homes it sometimes is necessary to use a single-directional closed-string stair, especially in large rooms.

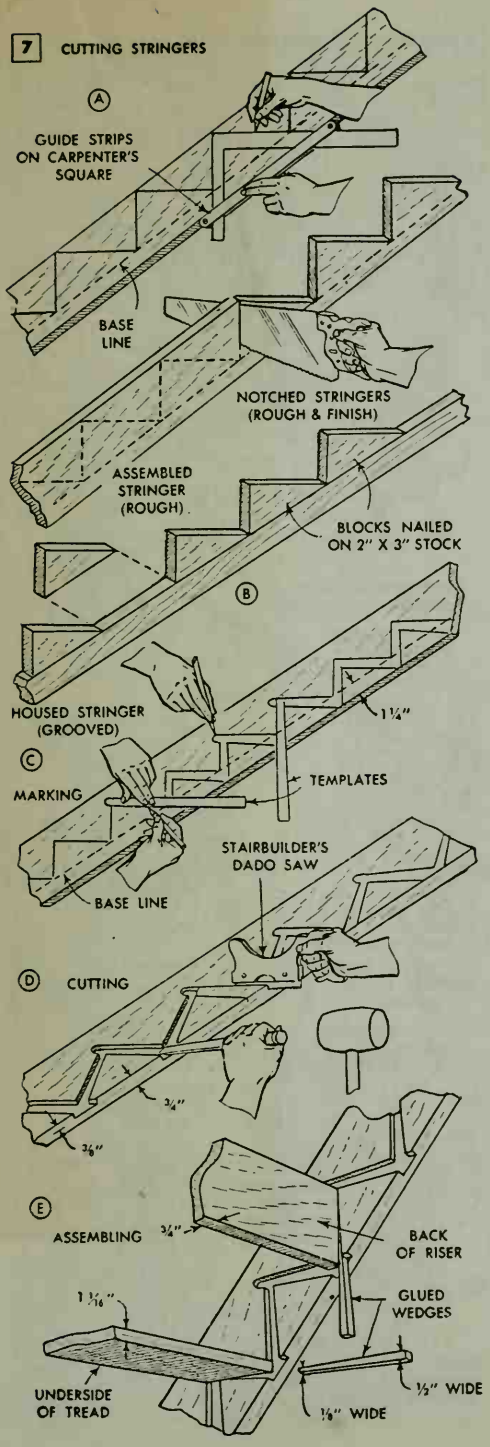
In determining the step proportions for an average stair, use measurements of the typical step shown in Fig. 2. These dimensions should not be varied more than ½ in. either way, except in some special cases, such as on long flights made possible by ample space in large homes and buildings. On



these stairs, a rise as low as 6 in. and a tread as wide as 11½ in. may be used. Actual measurements will depend to some extent on how many steps of this proportion can be fitted into the stair space. To determine the number of risers for a given stair, first divide the total rise by the step rise, or a figure close to it that will give an even result. Then to get tread measurement divide the total run by the number of treads, always one less than the number of risers.

The stair opening, or well, should be cut wide enough and long enough to provide adequate headroom, Fig. 3. Remember also that dimensions of the opening must allow for the finish stringer, upper-floor nosing, and space for a rail. For example, the total finish allowance for the ordinary 36-in. single-flight open-string stair ordinarily would come to 5 in. These figures are based on ¾-in.-thick plaster wall and a standard 2⅜-in.-wide rail, plus 1 in. minimum finger room between the rail and wall. Always check walls of the stair well with a level and straightedge to determine beforehand the allowances for out-of-plumb walls, corners and other irregularities.

In planning the installation of a stair in a new location, which often is done in making alterations in old houses, obstacles that interfere with the placement of the stair well may be encountered. These may be supporting main beams or joists, chimneys or other installations that cannot be moved. If the obstacle is at one end of the proposed opening, the loss in length sometimes can be compensated for by shifting the location of the stair in the opposite direction. If this cannot be done, then winding steps or landings, Figs. 4, 5 and 6, sometimes can be installed. However, there is a definite minimum total run as well as a minimum headroom. Built to any dimension under these limits, the stair is not only difficult to ascend or descend but actually may be dangerous in some locations. Fig. 6, A, B and C, detail the commonly used methods of building approaches to both open and closed stair flights. In detail A, three winder treads are used. Winders are tapered steps which pivot at the newel post. Here the nosing of the winder starting step is flush with the stair wall. Better construction is shown in detail B where the starting step is straight and extends its width into the room. Somewhat simpler construction of the open-string stair employing a landing is indicated in detail C. In laying out winders, the plan should be drawn full size as in Fig. 4. The tread width of winders is gauged by intersecting the foot line, which represents the normal path of travel on winding steps, with a compass set to the tread width of the straight steps. When space is limited it is often necessary to include winders, and these may be quarter or half-space. They are often a source of danger and should be at the bottom of a flight of stairs. Landings should be at intervals to ease the climb.



Only thoroughly seasoned lumber should be used in building a stair. Treads and risers in standard lengths and widths may be purchased. Treads preferably should be oak, dressed to 1 1/16-in. thickness. Risers usually are cut from pine, ¾ in. thick. Starting steps, built with curved ends to match standard rails and newel posts, nosing returns and cove moldings, also are stock items. Clear ¾-in. pine boards commonly are used for making finish stringers. Rough stringers are cut from 2-in. stock.

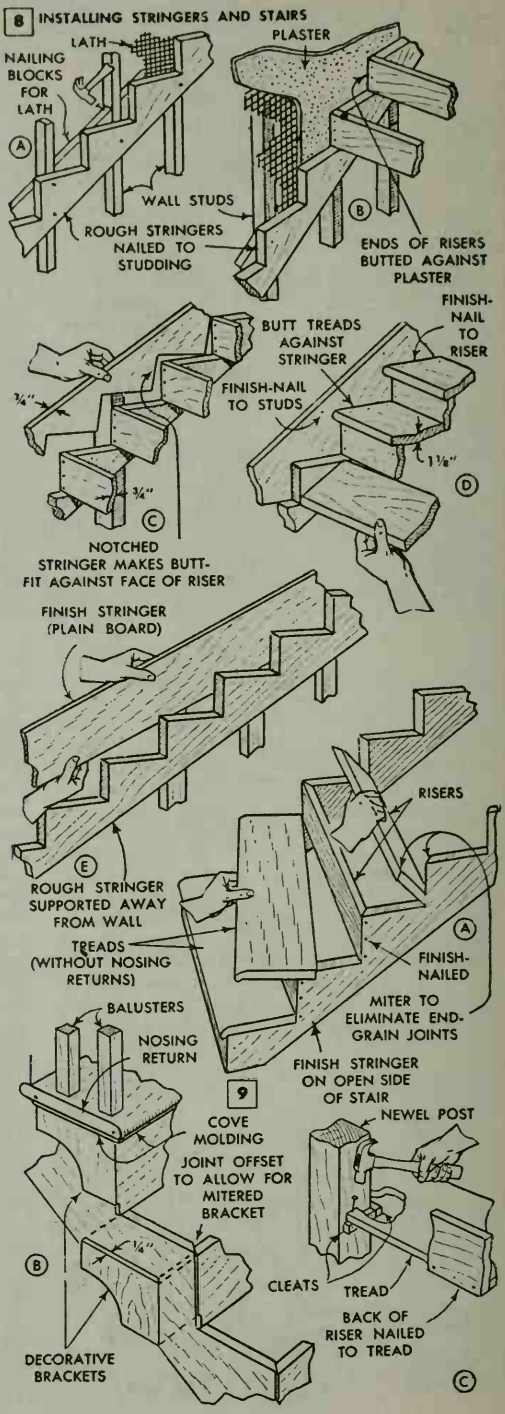
In building a stair, make the stringers first. They may be the open or notched type, details A and B, Fig. 7, or the housed type, detail C, depending on the method of stair installation. On either type, begin by laying out the rise and run of each step as in detail A. On a notched stringer make the saw cuts shown. On a housed stringer, locate and pencil the outlines of the grooves with the aid of two templates, one for the tread grooves and one for the riser grooves, as in detail C. Both templates must include an allowance for wedges, Fig. 7, E. When the layout is completed cut the grooves as in detail D. Be careful when chiseling out the waste to bring the grooves to a uniform depth. At this stage, cut risers and treads to width, but not to length unless the stair is to be assembled beforehand and installed as a unit.

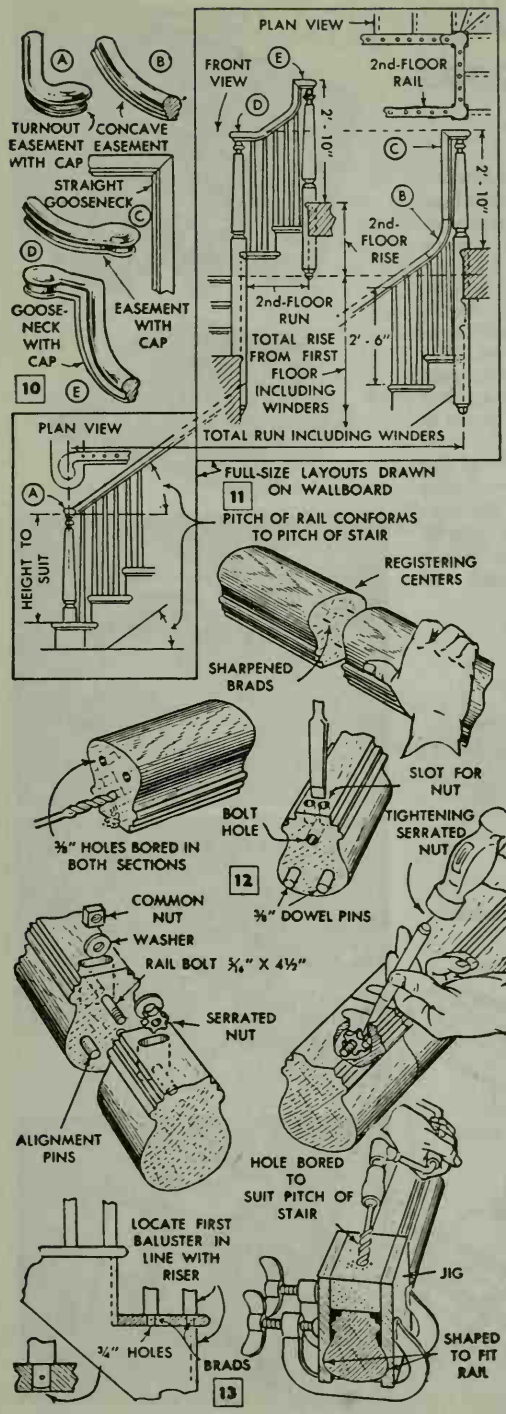
To avoid damage resulting from exposure to moisture in a new-house installation, the stair should not be installed until after the rooms have been plastered and have had time to dry out. However, where the rough-stringer method of construction is used, the stringers may be put in beforehand and temporary tread boards nailed on so that the stair can be put into immediate use. Finish the stair after the plastering is completed and thoroughly dried.

To install a closed-string stair in a plastered stair well, fasten the stringers to the walls by nailing through the plaster into the studding. Next, cut the treads and risers to length and wedge them in the grooves as at E in Fig. 7. Set the wedges in glue and be especially careful to drive them to a uniform tension. Where it is practical to support a notched wall stringer away from the wall, E in Fig. 8, a plain board can be used as the finish stringer, thus eliminating the need for notching or grooving. Slip the board down into the space between the

notched stringer and the wall and fasten with finishing nails driven through the plaster into the studding. Then install the risers and treads by butting them against the finish stringer instead of the plaster. Other methods of installing notched stringers are shown in Fig. 8, details A, B, C and D. A method of miter-joining the risers to notched stringers is shown at A, Fig. 9. The use of decorative brackets, detail B in Fig. 9, simplifies the miter-joining of risers and finish stringers on the open side of the stair, making it somewhat easier to produce neatly finished edges, and affording a simple means of correcting open joints caused by errors or inequalities of lumber. Anchor newel posts to the stair structure as shown in Fig. 9, detail C. If the installation permits working under the stair, the groove-and-wedge method as used with housed stringers may be employed for anchoring steps to posts, instead of the cleat-and-nail method shown at C. Wedges produce a tighter job. When installing a stair on subflooring, which is common practice, be sure to allow for the thickness of finish flooring by making corresponding increases in the width of the bottom riser and the length of the stringers and newel post.

An attractive stair rail not only is of decorative value, but it's an essential part of every stair as it reduces the accident hazard to the minimum. The rail must be rigidly mounted on newel posts that have been firmly anchored in the stair structure, and it should be capable of withstanding more than normal strain. To aid stairbuilders in doing good rail jobs at reasonable cost and with a minimum of hand work, ready-made rails are preferable for use on stairs of common measurements. These come in sections that are assembled on the job. Matching newel posts and balusters should be obtained with the rail. If the stair follows a normal layout with average run-and-rise measurements, it is easy to fit these standard parts. To determine the dimensions of parts needed, draw full-size plan and elevation layouts. A typical layout of the balustrade is shown in Fig. 11, the parts lettered A to E inclusive, Fig. 10, being shown in position in the plan view, Fig. 11. A common procedure is to assemble the rail in flight units, beginning at the lower, or starting, newel. First bolt the easement section of the rail to the starting newel cap. Join the gooseneck section of the





rail to the landing-newel cap. Then bolt the cap-and-easement units temporarily to the straight rail section, hold the assembly on the newel posts as in Fig. 1, and check the rail for length. Straight sections are joined with dowels and special stair-rail bolts as in the five steps shown in Fig. 12. Finally, complete the flight assembly by bolting on the cap-and-gooseneck unit. Assemble any succeeding flight units in the same way. In those styles where easements and goosenecks are not employed or in cases where factory-joined units are used, some of these special operations are unnecessary, of course. After the parts have been fitted and bolted together, fill openings and screw holes either with wooden plugs glued in, or with wood putty.

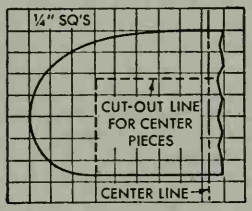
Balusters are fastened to rails in either of two ways, depending on the style employed. Square balusters, made to fit grooved rails, are held in position by means of spacers, or fillet strips, which are inserted between the balusters. Turned balusters are designed to fit into holes bored in the rails as shown in Fig. 11. Balusters of three different lengths are required for each step except the step directly under an easement, which takes a fourth size of extra length. To locate baluster holes on the rail, set it in place on the posts. Then raise plumb lines from the baluster holes in the step treads up to the rail, using a carpenter's level. Boring the holes at the required angle can be done accurately on the straight sections of the rail with the aid of the simple boring jig shown in the right-hand detail in Fig. 13. Holes in the curved sections of the rail must be bored freehand. In spacing balusters, locate the first one on each step in line with the riser as shown in the left-hand detail in Fig. 13.

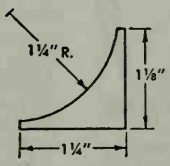
Before preparing a newly built stair for painting or varnishing, allow time for the wood to become adjusted to the atmospheric conditions in the house. Otherwise, slight shrinkage may loosen the filling in the joints and spoil the paint job. For this reason, it is best to do all other decorating work in the house first, leaving the stair to the last. Meanwhile, protect the treads from dirt and scuff marks by covering them with heavy paper held in place with cellulose tape. In painting the stair well do not get paint on the stair parts as it will be difficult to remove.

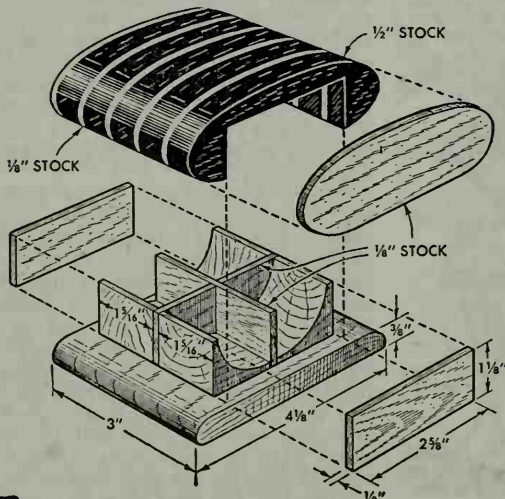
STAMP BOX
of contrasting woods

YOU WON'T have to search high and low for stamps if they're kept in this attractive box. The top is made of laminated woods in contrasting colors. Wide strips of walnut and narrow lengths of maple are ideal.

Details of assembly for the base are given in the lower half of Fig. 1. The compartment dividing strips are assembled with half-lapped joints and the filler blocks and ends are glued on. This assembly is glued to the base. In the upper part of Fig. 1 is shown the profile for the pieces that comprise the top. Jigsaw these so the grain is horizontal in the maple and vertical in the walnut. File any irregularities in the inside of the top, Fig. 2, assemble with the end pieces and glue together as in Fig. 3. A cleat nailed to the supporting surface will aid in aligning the pieces. After the top is dry, smooth the outside with a strip of sanding belt, Fig. 4. A waxed finish will bring out the grain nicely.







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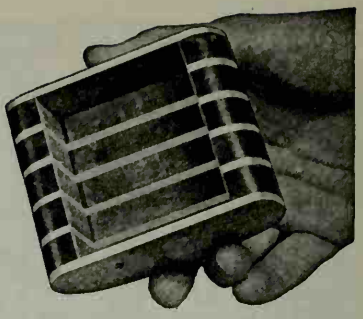

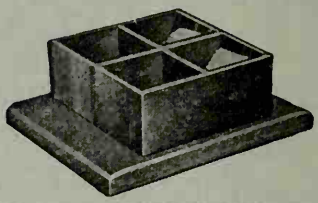

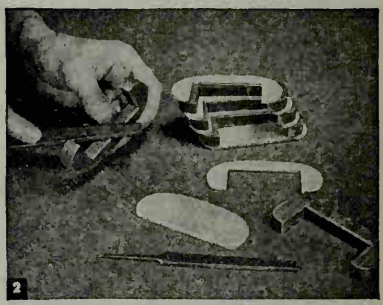

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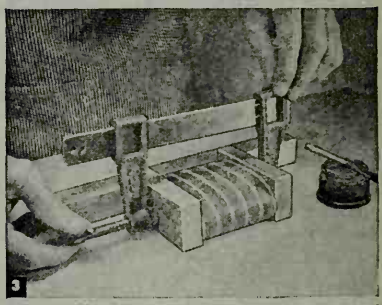

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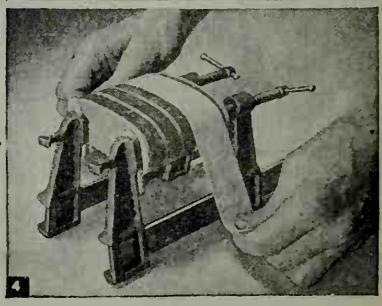
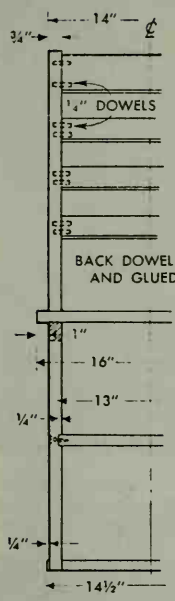


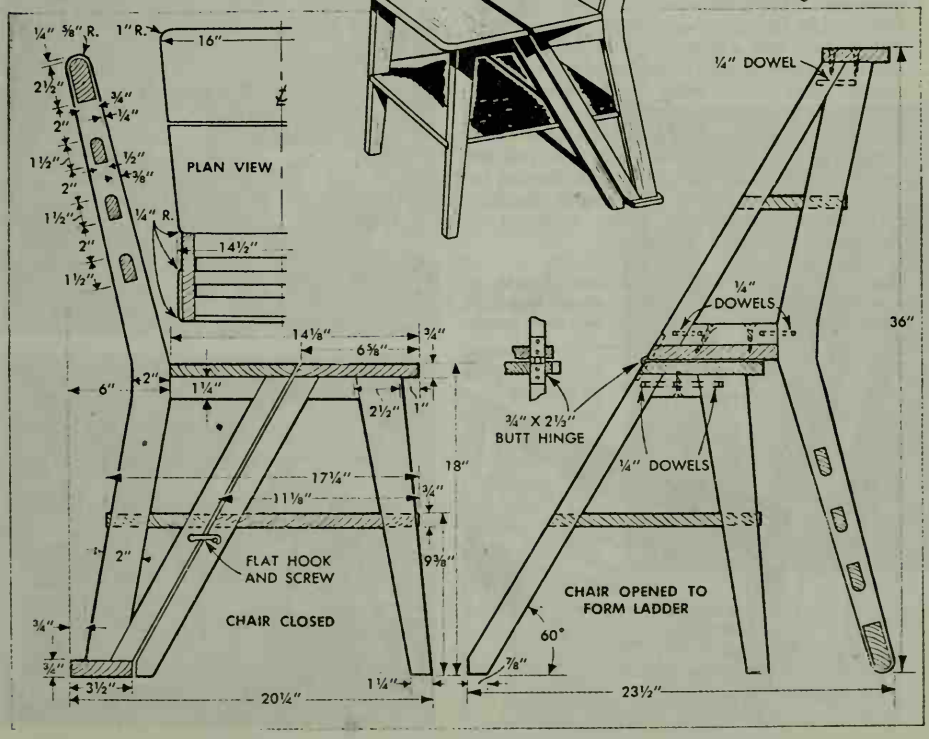
4

STEPLADDER



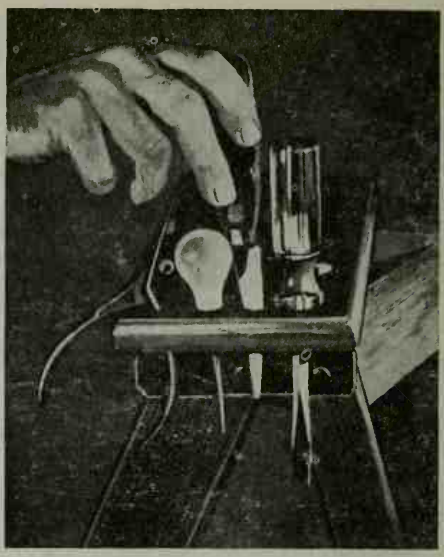
This unique chair, which quickly flips over to become a sturdy 3-ft. stepladder, will prove to be indispensable to the busy housewife. No longer will it be necessary for her to carry a cumbersome ladder or balance precariously on a step stool or chair to hang draperies and curtains or to reach high shelves. The chair may be made both attractive and comfortable with the addition of a removable cushion. Screws, driven from below, are used to attach the two-part wooden chair seat.

Doweled joints and hardwood construction (birch or oak) are recommended for additional strength. Hook at side, locks unit together when used as a chair

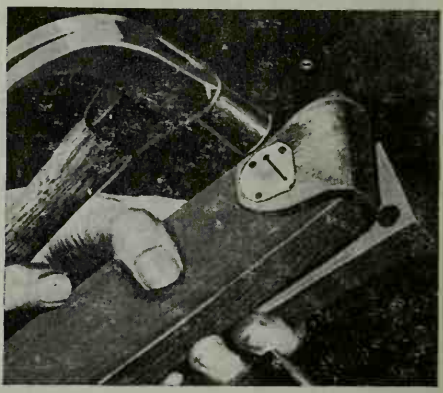


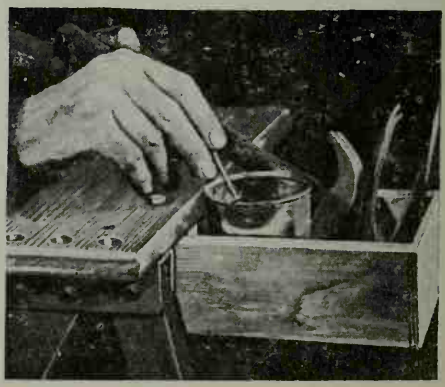
STEPLADDER STEP-SAVERS

WHY GO UP and down, up and down on your stepladder while doing repair work, when a few additions to the ladder can save you the extra steps? For example, a pivoted drawer that swings under the ladder top will hold all sorts of objects, and paint cans placed in it are not likely to spill. The drawer should be just wide enough to swing without binding against the ladder leg. A hardwood block glued into one corner is drilled to receive a ¼-in. bolt on which the drawer pivots. A small compression spring between washers on the bolt holds the drawer tightly against the ladder top, and a stop block of wood under the top limits drawer movement. Another handy kink is to bore ½-in. holes 1 in. apart near the ends of the ladder top for screwdrivers, pliers and other small tools. Finally, as a safety measure and to reduce marring of floors, the ladder legs should be equipped with shoes. Rubber or leather belting is folded around the bottoms of the legs and nailed in place.

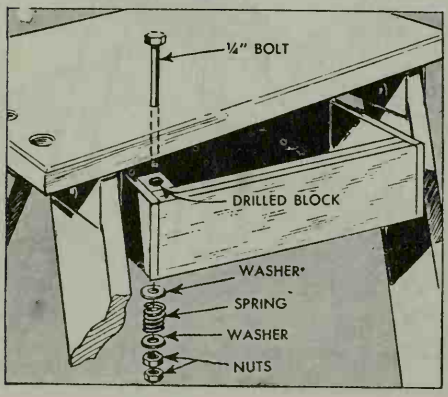


Above, holes drilled in ends of ladder top to hold small tools. Below, shoes of rubber belting with the corners trimmed nailed to bottom of ladder legs

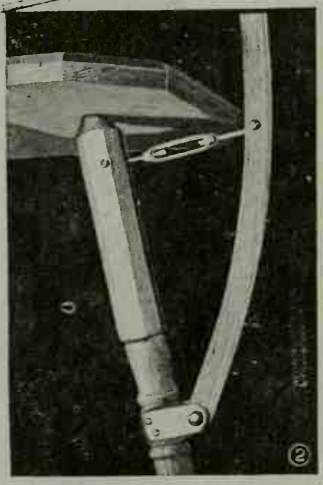




Below, width of pivoted drawer is same as width of ladder top. Lower right-hand photo shows drawer in working position, holding paint can and tools handy

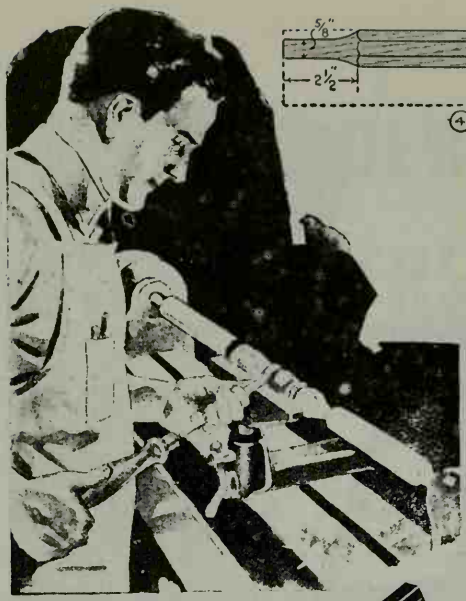


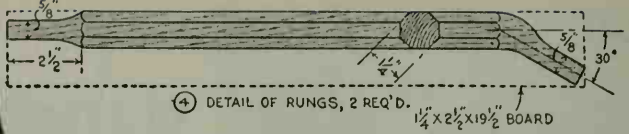
STOOL
has adjustable back



SUITABLE for use in either your kitchen or home workshop, the sturdy, well-designed stool shown in Fig. 1 has a back that can be adjusted quickly by means of a turnbuckle as in Fig. 2. Oak or maple is the best wood to use for making it, although other hardwoods will serve.

Begin construction with the three legs, which are turned to the dimensions given in Fig. 3, one end of each leg being turned to provide a ¾-in. tenon. Following this, each leg is sawed and planed to a straight, octagonal taper which reduces



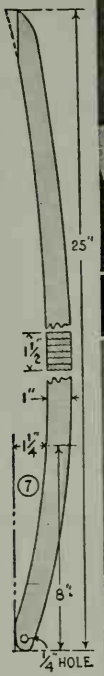


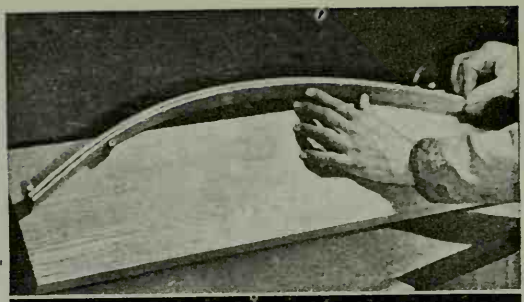
from 1¾ in. at the tenoned end to 1½ in. at the lower end. The additional turning at the center of the leg is optional, but adds to the appearance of the stool. Two rungs are required. Due to the angle of the tenon at the rear end, it is necessary to saw these from stock that is 2½ in. wide as indicated by the dotted lines in Fig. 4. This done, the major section of each rung is planed to an octagonal shape and the ends formed with a spokeshave as in Fig. 5, to provide tenons ⅝ in. in diameter.

The seat, back and footrest are cut from 1-in. stock to the shapes and dimensions given in Fig. 6. It is well to guard against warping by making the seat in three pieces glued and doweled together. Special care must be taken when boring the ¾-in. holes into which the leg tenons fit in order to give the legs the desired spread. An 8-in. circle is scribed on the underside of the seat and the locations of the three holes are marked equidistantly on the circle, the rear one being located on the centerline of the seat. Then, ¾-in. holes are bored into the underside, taking care to avoid letting the tip of the bit break through the top of the seat. The rear hole should be bored at a 10-degree angle from the vertical so that the rear leg will extend outward. Then the two holes for the front legs are bored at a 15-degree angle. When boring these

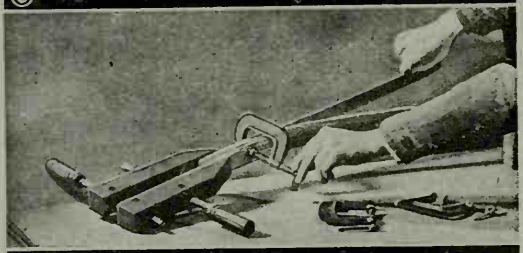
holes, you must keep the bit lined up with the radial lines drawn from the center of the circle to the points where the holes are started. Also, as an aid in getting the angles correct, you can use small blocks having one edge inclined the desired angle as a guide for the bit. The blocks are clamped to the seat while boring.

Next, without applying any glue, the legs are fitted into the seat holes and are marked to determine the position of the rungs and footrest. The holes for the rungs must be bored at an angle so that the rungs will be parallel to the edge of the seat. Likewise, the footrest is notched to fit the front legs and is doweled or screwed to them. After this preliminary fitting has been done, the parts are reassembled permanently with glue.





First, two glue-coated strips are sprung around dowels set in a flat board and left 24 hrs. to dry ⑧



Then the two strips are removed from the form and additional strips are glued to them, one at a time, letting each one dry before adding the next ⑨

The backrest is screwed and glued to a curved support piece, detailed in Figs. 7 to 9. Although it can be sawed from a single piece of hardwood it will be stronger if glued up from 3/16-in. strips, using a form to obtain the curvature. Pieces of flat iron screwed to the rear leg provide a pivot link for the back support and a 6-in. turnbuckle permits adjustment.

Section of Old Bicycle Frame Provides Workbench Stool

Mounted so that it pivots out of the way under a workbench when not in use, this handy seat is provided by cutting the saddle section from a discarded bicycle frame and installing it as shown. Two lengths of pipe are joined by a coupling and attached to the floor and underside of the bench by floor flanges. The pipe is cut in lengths which, when joined together with the coupling, will in turn permit the coupling to support the seat at the desired height. A hole is tapped in the pivoting joint to take a thumbscrew with which the unit may be locked in place under the bench.

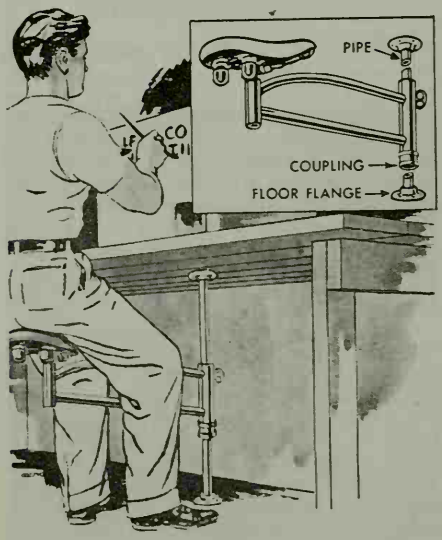


FIG. 1 Photo courtesy Douglas Fir Plywood Assn.

Many bedrooms offer opportunity for spacious, reach-in wall wardrobes where well-organized arrangement makes full use of doors as well as space inside, and may eliminate need of separate vanity and chest of drawers

STORAGE SPACE

YOUR LACK-OF-SPACE problems often can be solved by simply reorganizing existing space to better advantage and greater convenience. This applies particularly to storage problems. A small floor area can be multiplied many times in shelf area that can be concealed in a cabinet. Storage cabinets may be built in permanently or they may be portable, permitting a change of location. Wall wardrobes or "storage walls" that open up completely with hinged, sliding or folding doors, provide quick and convenient accessibility.

In small bedrooms a wall wardrobe like the one shown in Fig. 1 practically eliminates the need of a separate vanity and chest of drawers. The boy's room shown in Fig. 2 has a built-in bunk with cabinet space under it, and is combined with a clothes closet at one end, a desk and book shelves at the other, and also conceals the clothes closet of an adjoining room. A window seat may be a continuation of wall cabinets as in Fig. 3, and provides a good storage place for blankets during summer months. One of the most natural locations for built-in cabinets is the area under a low, sloping ceiling in an attic or on the second floor, where the floor space cannot be used to advantage for placing furniture. Fig. 4 shows a restricted space of this kind, and Fig. 5 shows how it was transformed by installing a cabinet. Fig. 6 shows a somewhat similar arrangement in which case the cabinet also included a drop leaf to serve as a desk, and a tier of open book shelves.

Wall wardrobes: Reach-in wall wardrobes provide more usable space than walk-in closets of the same size. Sliding or folding doors have an advantage in not requiring extra space for opening them. However, full-width swinging doors can be fitted with narrow shelves, Fig. 1, a midget vanity, Fig. 7, or with any of numerous attachments as shown in Fig. 8-B. The inside of wall wardrobes may include shelves, trays or drawers in addition to clothes-hanger rods. Tiers of drawers may open into the

FIG. 2

FIG. 3

Photos courtesy Western Pine Assn.

Bunk-and-cabinet combination of knotty pine, Fig. 2, and the cabinet and window seat having storage space below for blankets, Fig. 3, utilize space otherwise wasted. Low headroom of sloping roof, Fig. 4, prevents good furniture placement; can be used to much better advantage by cabinets and drawers as in Fig. 5

FIG. 4

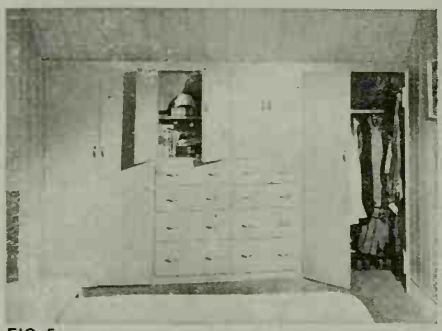


FIG. 5

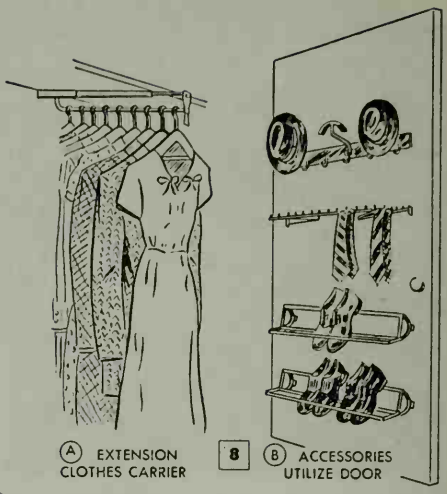
room directly, or may be concealed behind the cabinet doors.

Where a cabinet must be made shallow because of limited space, it is best to use extension clothes-hanger rods installed at right angles to the wall as shown in Fig. 8-A. Where more space is available, it is better to have the hanger rod parallel to the wall as shown in Fig. 1. This arrangement requires a minimum of 22 in. for the inside width of the cabinet. An outside width of approximately 24 in. is often used for wardrobe cabinets as the sides then can be cut from standard 4-ft. panels of plywood or wallboard without any waste. About 2 ft. of hanger-rod length is considered minimum allowance per person. Floor-to-ceiling height in cabinets generally permits the installation of two shelves above the clothes-hanger rod. The shelves should be accessible through doors at the top.

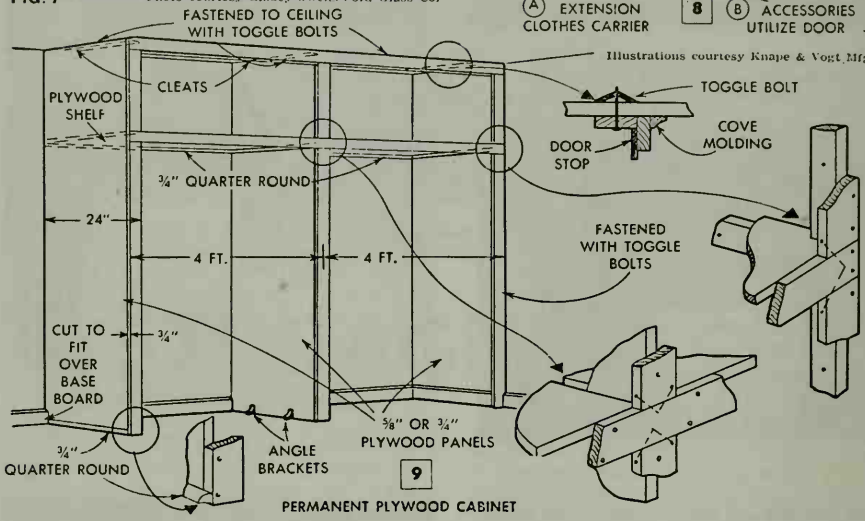
FIG. 6

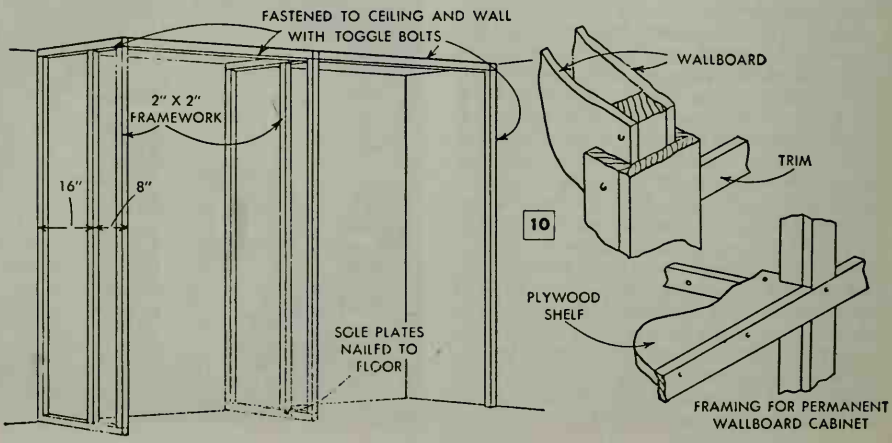
Photos courtesy Douglas Fir Plywood Assn.

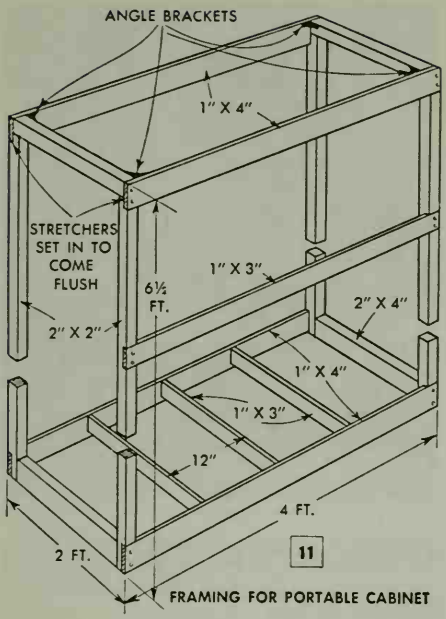
FIG. 7 Photo courtesy Libbey-Owens-Ford Glass Co.



Illustrations courtesy Knape & Vogt Mfg. Co.







FRAMING FOR PORTABLE CABINET

Construction of permanent cabinets: Simple and economical methods of building permanent cabinets of plywood or wallboard are shown in Figs. 9 and 10. The walls of a room may serve as the back and as one or both sides of the cabinet. The ceiling and floor of the room enclose the cabinet at top and bottom. This arrangement cuts down the cost of materials considerably and is much less expensive to build than a portable cabinet of the same size as the latter must be completely enclosed.

Fig. 9 shows the construction of a permanent cabinet made of ⅝ or ¾-in. plywood. Because of its structural strength no framing is required. Plywood is used for the end panel and partition, for the shelving and the four doors. At the top the panels are nailed to cleats fastened to the ceiling, for which toggle bolts or other types of screw anchors are used. At the bottom the panels are fastened to the floor by means of small metal angles, or to cleats nailed to the floor. After the shelves are installed on ¾-in. quarter-round or regular shelf-supporting molding, the front trim is applied as shown.

Fig. 10 shows a less expensive cabinet of similar size consisting of ¼-in. wallboard or hardboard on a framework of 2 by 2-in. stock. Plywood of ¼-in. thickness also can be used for covering material. Where wood planks such as knotty pine are used, the framework must have crosspieces at the center. For a finished appearance the inside may be covered with wallboard.

FIG. 12 Photo courtesy Western Pine Assn.

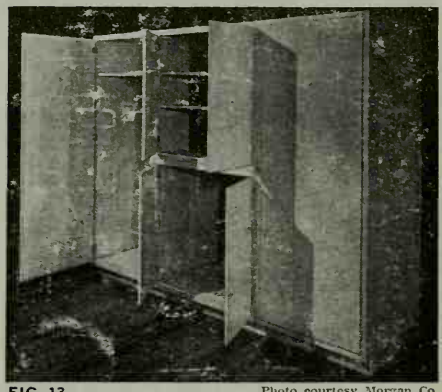


FIG. 13 Photo courtesy Morgan Co.

Portable cabinets: Portable cabinets must be made rigid. Generally they should not be longer than 4 ft., not wider than 2 ft., and not higher than 6½ ft. These dimensions permit them to be passed through doorways easily. Those made of ⅝ or ¾-in. plywood do not require any framework, and can be made strong and rigid if assembled with glue and screws. However, a complete frame is always required for such cabinets if they are to be covered with wallboard or hardboard. Construction of framework is shown in Fig. 11. Notice how the front and rear crosspieces are set in, and how corners are made more rigid by means of angles. Prefabricated portable cabinets are also available in a variety of styles and sizes. Fig. 13 shows one of these which is adaptable to a number of applications. It comes as a knock-down kit, to be assembled and finished by the user.

Cabinet doors: Two doors are used generally for cabinet sections 4 ft. wide; separate doors for upper and lower compartments. Five-ply, ¾-in. plywood is most

FIG. 14

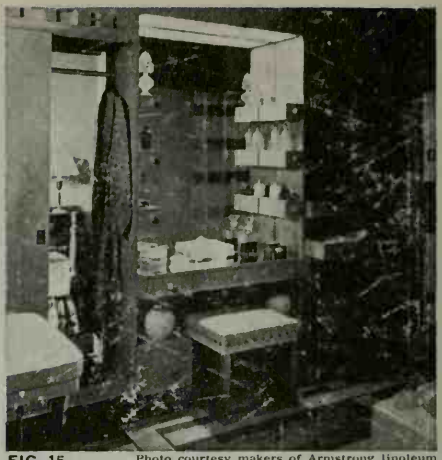


FIG. 15 Photo courtesy makers of Armstrong linoleum

AS AN ENTRANCE CLOSET AND BOOKCASE

16

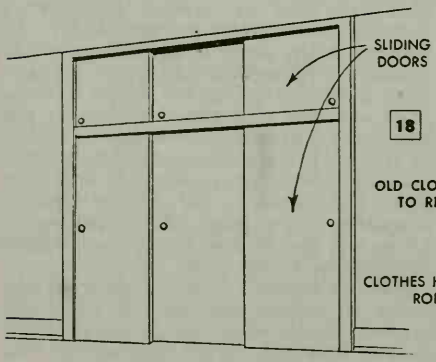
CABINET HIDES OPEN STAIRCASE

17

resistant to warping. Door stops and catches for swinging doors may be placed along the top edges, and the doors should come flush with the trim.

Varied designs and applications: Cabinets of the kind described can be built on either side of windows. You can vary the length of a permanent cabinet to suit available wall space. A vanity, chest or desk can be located between two cabinets, or at one end as shown in Fig. 12. Where bedroom floor space is at a premium, cabinets can be recessed to take the heads of beds or other pieces of furniture as shown in Fig. 14.

A storage wall built between a bedroom and a bathroom is shown in Fig. 15. The center portion is a vanity backed with a large mirror and illuminated with a flush ceiling fixture. On one side is a wardrobe for clothes, which is accessible from either the bedroom or bathroom through sliding doors. On the other side tiers of drawers are located, both in the bathroom and bed-



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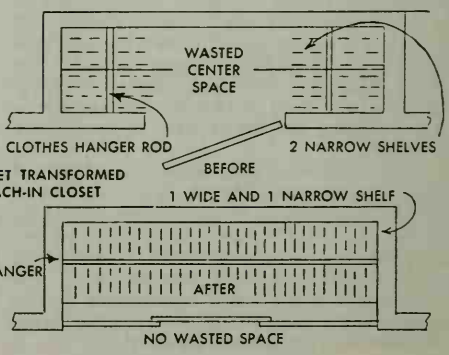


OLD CLOSET TRANSFORMED TO REACH-IN CLOSET

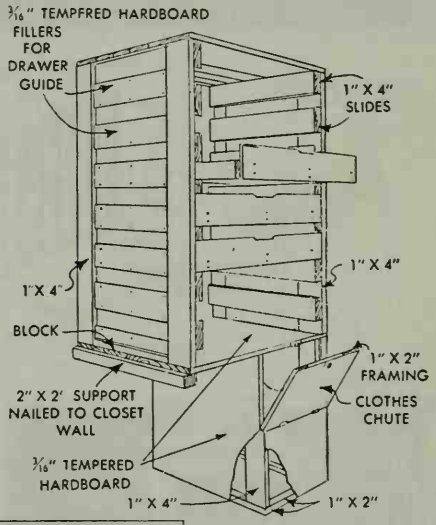
FIG. 19 Photo and illustration courtesy Masonite Corp.

FIG. 20 Photo courtesy Holcomb & Hoke Mfg. Co. Inc.

room. When not needed they are concealed behind sliding doors.

Cabinets of the wardrobe type also can be used to advantage in other parts of the house. Where the front door of the house opens directly into a large living room, a portable cabinet can function as an entrance closet. Fig. 16 shows two cabinets placed end to end. One is an entrance closet. The other has horizontally divided compartments, the upper one fitted with bookshelves and the lower one arranged for storage. The latter should accommodate card tables as shown. Often entrance cabinets can be located to conceal part of a stairway as shown in Fig. 17.

Changing walk-in closets: Shallow walk-in closets can be made much more convenient, and their capacity can be increased as



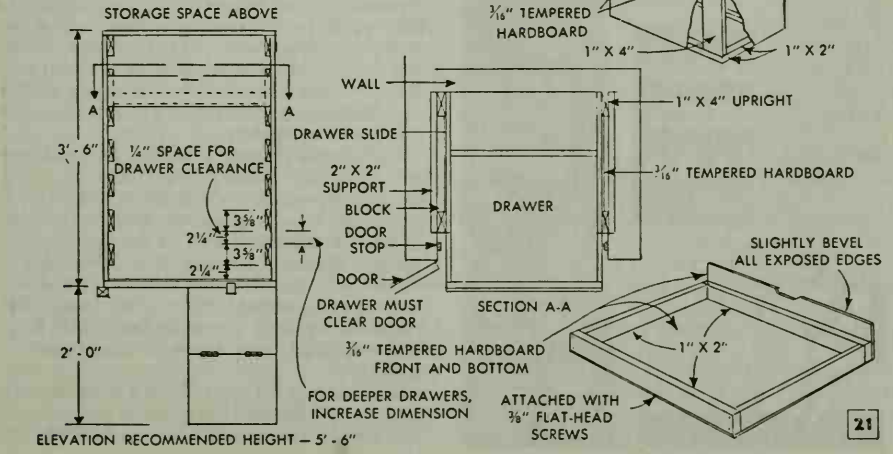


FIG. 22 Photo courtesy Masonite Corp.

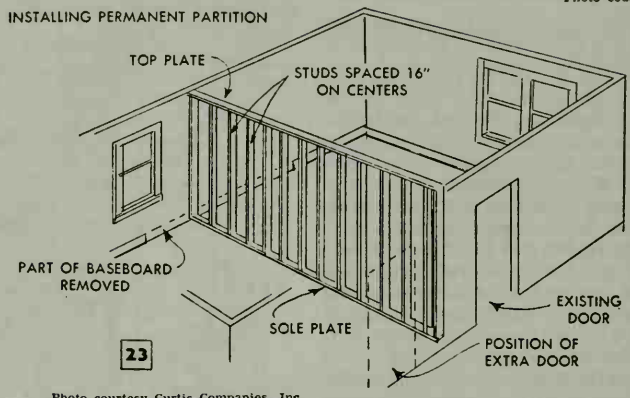


FIG. 24 Photo courtesy Curtis Companies, Inc.

much as one-third by simply transforming them to reach-in closets as shown in Fig. 18. Instead of using hinged doors requiring free floor area for swinging, sliding or folding doors are preferable. Fig. 19 shows a folding door on a somewhat wider closet, previously inconvenient because of its length. The folding door also offers better illumination and ventilation.

Hall linen closets also can be improved by installing sliding trays as shown in Fig. 20. Construction is detailed in Fig. 21. Notice that tempered hardboard is used for drawer bottoms as well as for covering. A clothes chute to the basement can be provided on a first floor by simply cutting and boxing an opening between two joists. This requires cutting through both the finish and subfloor, and through the basement ceiling.

Two rooms for one: Where an additional bedroom is needed for greater privacy, you can divide a large one into two by installing

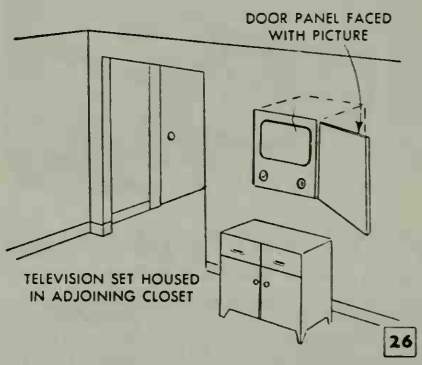
FIG. 25 Photo courtesy Johns-Manville

a storage wall as shown in Fig. 22. Making two rooms out of one in this way makes a big saving by eliminating the probable alternative of building an extra room in an unfinished attic. Such a storage wall may extend almost across the room, leaving a doorway which can be fitted with a door. The room can be restored to its original size at any time by removing the cabinet.

To divide a room permanently, you install a regular partition as shown in Fig. 23. Although 2 by 2-in. stock may serve for studs and plates, 2 by 4-in. stock produces a more rigid wall. You first remove the baseboard and shoe molding, and also any molding at the ceiling. After marking the location of the partition, nail the sole plate to the floor. You can attach the top plate directly under the plaster of the ceiling. If it crosses joists or comes under one lengthwise, you fasten the plate to these with 16-d. nails. Where the partition plate comes under a space between two joists, you use toggle bolts or screw anchors.

The end studs are toenailed to the plates and fastened to the walls. Then other studs are installed at 16-in. centers. Any type of suitable wallboard such as described in Section 11 is then applied, followed by trim. Such a wall on 2 by 4-in. framing may have recessed portions to accommodate shelves for books or knickknacks.

Utilizing other waste space: For putting things out of sight, yet readily accessible, there are many other spots in the average house that can be put to profitable use. Perhaps the area under a stairway is just the place for an extra powder room. Don't



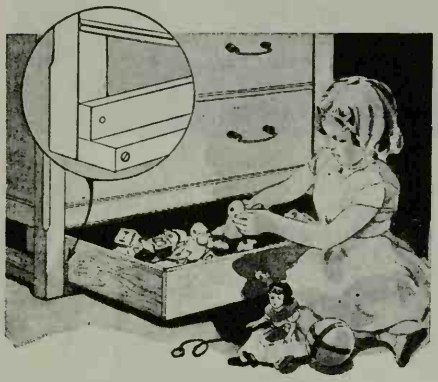
overlook the opportunities that many corners offer for the installation of attractive corner cabinets such as the one shown in Fig. 24. Walls of attic rooms may be recessed as in Fig. 25 for wide pieces of furniture such as a day bed, vanity, desk, radio, phonograph or television set.

One method of saving the space in a living room or den, which is usually sacrificed to accommodate a television set, is to locate the set in an adjoining closet as indicated in Fig. 26. For this an opening must be made in the wall at the desired height for the screen, controls and speaker grille, and perhaps located over the present radio set. The opening is framed and may be closed when not in use by providing a single or a double door. It can also be concealed by means of a picture, in which case offset hinges are used, the framed opening then being extended about 1 in. from the wall surface.

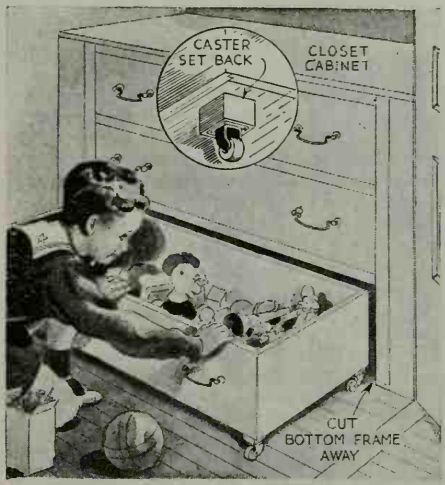
STORAGE SPACE

Child's Toys Stored in Drawer Under Chest or Dresser

Living in a small apartment where space was restricted, one father added an extra drawer to a dresser in which his small child could store its toys. Slides were provided between the dresser legs as shown, and the drawer was finished to match the dresser, thus providing the extra drawer space without detracting materially from the appearance of the furniture.



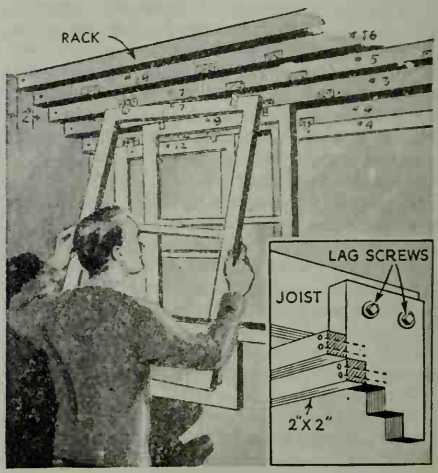
Mobile Drawer Provides Storage For Child's Toys



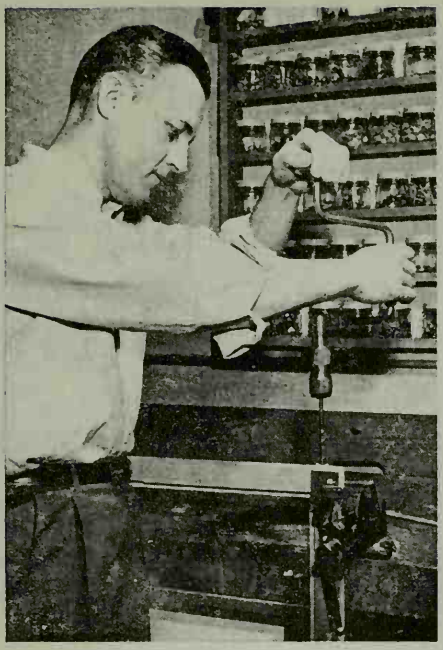
If you have no place for the children to keep their toys, this mobile drawer will solve the problem. It can be moved about as desired and, when not in use, slides into the lower part of a drawer tier in a closet. If you already have drawers built in the closet, the lower one can be converted easily. Just remove the slides, guides and lower apron and attach a caster to each corner of the drawer. It may be necessary either to reinforce the drawer bottom or replace it with a heavier one.

Rack for Storing Storm Sash

The problem of storing storm sash and window screens was solved by one man who hangs them on a rack like the one shown, where they are safe from breakage or other damage. Bolted to the ceiling joists or wall studs, the rack supports the sash and screens well above the floor in space not utilized in the average basement or garage. The rack consists of two end-pieces step-cut as indicated in the detail to receive 2 by 2-in. strips nailed to them. Hangers like those holding the sash and screens on the windows are screwed to these strips so that sash can be hung from them, each pair of hangers being numbered to correspond with the window to be hung on it. With this arrangement, each sash is hung on the rack as soon as it is removed from the window in the spring, at the same time taking down the screen from the rack and putting it on the same window.



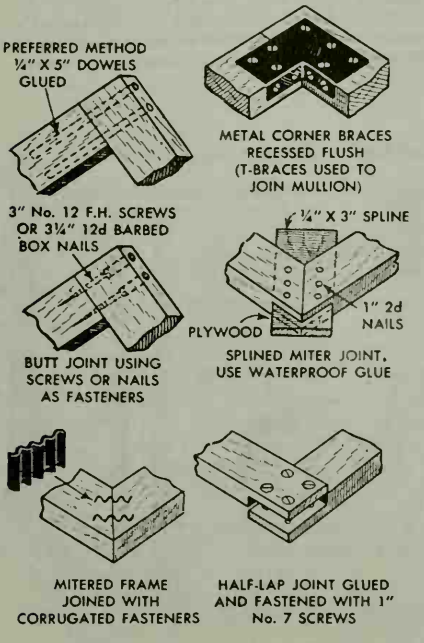
STORM SASH

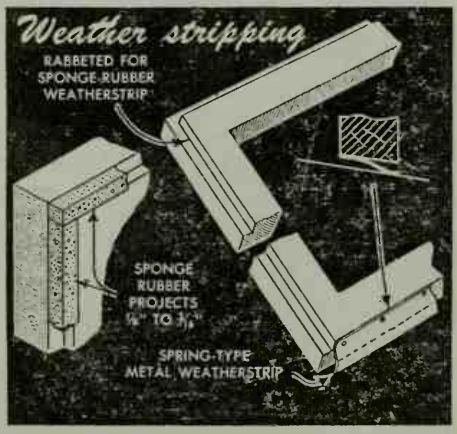


ONE OF THE most practical home-workshop projects is making your own storm sash and screens. In addition to the cash saving, there are several other advantages to be gained by doing the job yourself. For example, you can make the convenient divided storm sash with a hinged lower section, sealed inside storm sash which prevent condensation on metal casements and screens with sturdy, durable frames. All homemade storm sash can be sealed with various types of weather stripping to prevent air leakage. These special features are not ordinarily available in the regular product.

The details at the lower left show six different methods of corner-joining sash frames. Of course, the same methods can be used in joining screen frames of either the full or half-length type. Of all the types of joints suggested, the doweled joint, the splined miter and the miter joined with corrugated fasteners get the highest recommendation. Material for the stiles (vertical members) is available ready-cut to recommended sizes, usually 1⅛ x 2⅝-in. sectional size, in clear white pine. By ripping the bottom and top rails and the center muntin of screen frames from standard 1⅛-in. stock lumber, you can obtain a stronger, more rigid frame at less cost per unit. This is done simply by making the bottom rail 3 to 5 in. wide instead of the usual 2⅝ in. The lower left-hand details on the facing page show average sectional sizes of the three cross members with ½ x ½-in. glass rabbets. Rabbets of the same size are cut on the stiles. Now, note in the circled detail how the rabbeted parts are joined at the corners, using dowels and waterproof glue. The raised section between the inner

Typical corner joints

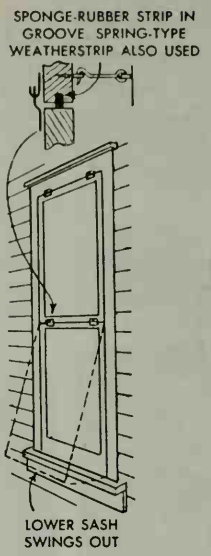




and SCREENS

face of the rabbet and the back face of the stock is cut away to permit the rail to butt against the stile. The same method of joining can be used when making screen frames which are rabbeted for the screen molding, as will be seen from the sectional details on the following page.

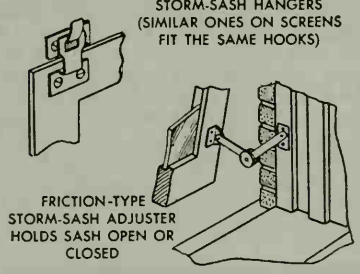
Pictured and detailed at the right is the special storm sash with a lower section pivoted on hangers, or hinges. As you can see, it is quite simple to make and on second-floor windows the use of a hanger permits installing and removing the lower half from the inside. By making a matching screen frame, it is not necessary to remove the upper half of the outer sash during the summer season. Be sure to use a sponge-rubber or a spring-type metal weather strip between the upper and lower sash as shown in the detail. This prevents seepage of water at the open



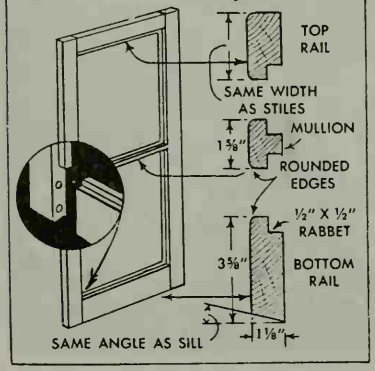
Hanging divided storm sash

A divided storm sash arranged so that it may be removed and installed from the inside is a great convenience. By attaching the lower half with hongers and making an interchangeable screen frame, it will not be necessary to remove the upper half of the sash during the summer season

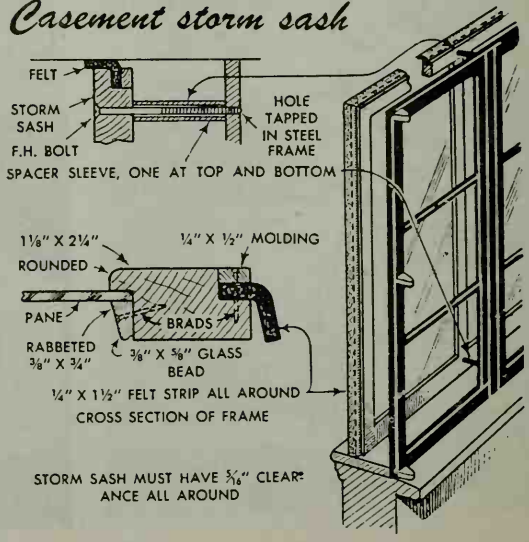
Storm-sash hardware

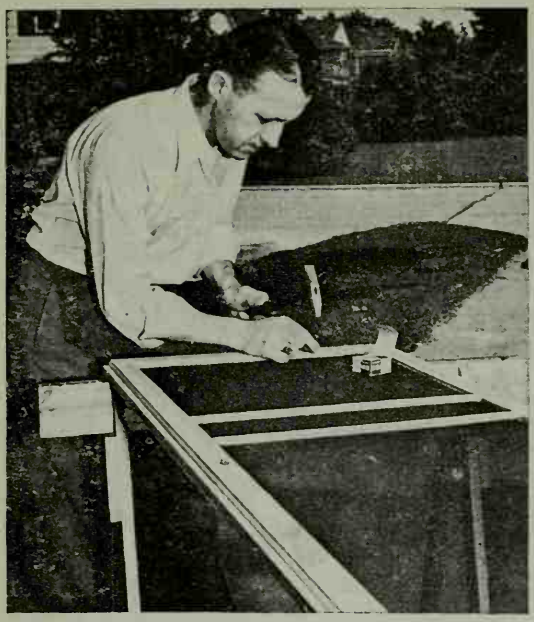


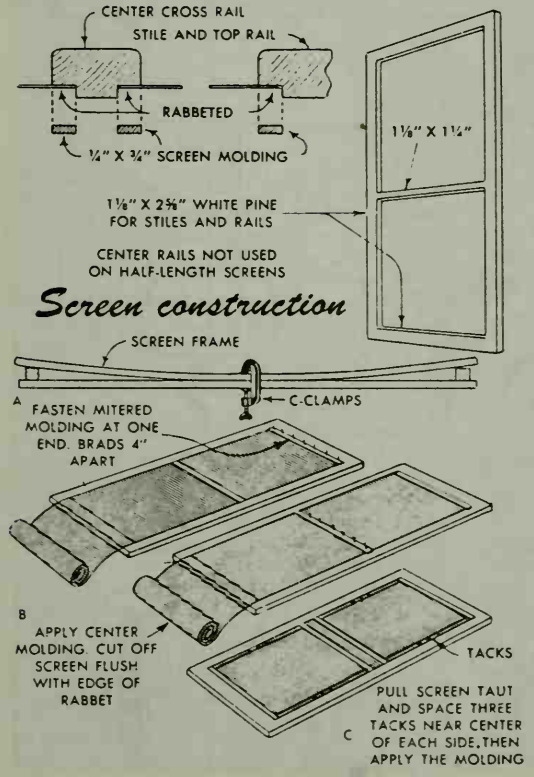
Frame sizes



Casement storm sash







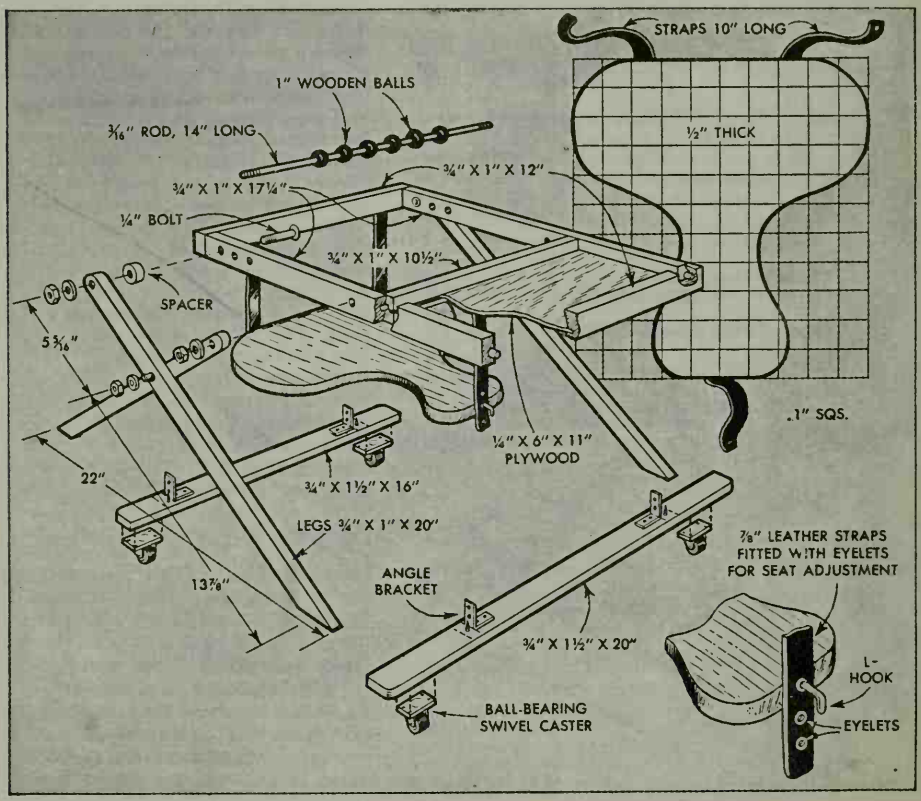
joint. Also, it's a good idea to install the friction-type sash adjuster on the lower half of the sash so that it may be opened and held at any desired angle during mild winter weather. This special type of sash adjuster is shown in one of the details on the preceding page.

It is usually possible to fit storm sash over metal casement windows by installing them on the inside of the frame as in the lower right-hand details on the preceding page. Note that the special sash is attached with spacer sleeves and long bolts which turn into holes tapped into the casement muntin. The edges of the storm-sash frame are trimmed down to allow 5/16-in. clearance all around then rabbeted to permit the installation of a felt weather stripping. This is held in place with ¼ x ½-in. molding strips attached with small brads. The glass is held in place by a bead instead of putty, as shown in one of the cross-section views.

After outside storm-sash frames have been finished and assembled, apply a priming coat of paint and permit it to dry thoroughly before installing the weather stripping and glass panes. The latter should be cut to fit in the rabbets with clearance all around. Lay a thin line of putty in the corner of the rabbet, set the pane, drive glazier's points spaced 6 to 8 in. apart and then putty the joint. Be sure, before applying the finishing coats of paint, that the putty is thoroughly dry, as otherwise the paint will peel. The details at the left show the procedure in making full-length screen frames. The method of making the half frame is the same except that the center muntin is omitted, of course. Although making and fitting the doweled joint takes more time, this type of joinery is by far the most durable on woodwork exposed to weathering. Note that in the detail of the assembled frame, the width of the lower rail is given as the same as that of the stiles and top rail. A stronger and more rigid frame will result if the lower rail is ripped at least 3 in. wide. Details A, B and C show how to attach screen wire to the frames. Priming and painting procedures are the same as outlined for storm sash.

STROLLER

HERE'S A PROJECT for the proud craftsman-father to have ready when baby shows signs of walking. Featuring a suspended seat which can be removed or swung aside when he becomes bolder, the walker doubles as a lightweight stroller which promotes good posture through its free-swinging seat. Details below show how the various members go together, and the little material required should be easy to find in the shop scrap box. The straps supporting the seat are attached with screws to the top framework, while the lower ends are fitted with eyelets for unhooking the seat. Metal corner angles are used to add rigidity to the legs. In painting the stroller, select a nontoxic paint that will not be harmful to the child.



Repair cracked STUCCO before painting

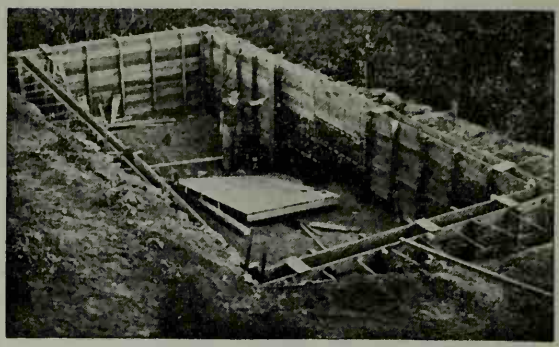
ANYONE can patch cracked stucco, which should be repaired as soon as possible. Cracks not only mar the appearance of the building, but also permit the entrance of moisture, which damages the structure underneath. First, with a hammer and chisel, cut away all the loose, crumbling pieces from the cracks and holes, after which the edges of the holes and larger cracks are undercut or beveled toward the bottom of the opening to help anchor the new stucco in place. Next, mix the patching material as indicated above, using a box and hoe if a large amount is required. Lime paste in the formula is powdered, hydrated lime mixed with water to a soft, thick paste, the lime being given all the water it will soak up but no more. Since it is almost impossible to match colored stucco because of fading and staining by the weather, it is best to avoid coloring the patching mixture. Painting the building after repairs have been made is best. However, if you want to try coloring, add mortar or limeproof dry colors in place of some of the lime in the mixture, first mixing the color to a soft paste with water. After mixing the patching material, thoroughly soak the edges of the cracks and holes with water applied with a brush. Patching is done with a rectangular trowel. A hawk like the one shown in the lower detail is handy for carrying the plaster. For a sand finish, the trowel is covered with carpet. Deep holes and cracks are best patched in two coats. The first one is smoothed off at a point about ½ in. from the finished surface and then is scratched to give the second coat a tooth. Let the first coat dry and shrink overnight and wet it before putting on the finish coat. Cracks too fine to fill with stucco can be filled with the first coat of paint. Brick and stucco paints are formulated for good adhesion and sealing of the surface with the first coat. The first coat should be brushed over the fine cracks two or three times before painting the wall. Cracks too small for filling with stucco and too large to fill with paint are best filled with calking compound, applied after the prime coat. It can be painted over. Application is easy with a calking gun, using a ⅜-in. gun tip and gun-grade calking compound. The heavier knife grade is laid in with a putty knife.

SWIMMING POOLS

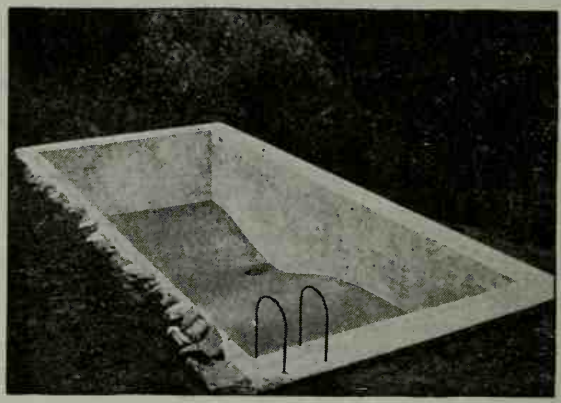
WHETHER it's large and elaborate or small and unpretentious, there's nothing like the privacy and convenience of a swimming pool right in your own back yard. And when you can do most of the work yourself or with the help of friends and neighbors, the cost can be kept well within the limitations of the average pocketbook. The suggestions and pointers presented here cover construction ranging from simple wading pools to a large family-size swimming pool.

When building a wading pool for youngsters, locate it on high ground if possible to simplify draining and also to save excavating, Fig. 1. A simple circular-shaped wading pool is shown in Fig. 2. A novel feature of this pool is a sprinkler head which is attached to a length of pipe and screwed into a coupling on the drainpipe. The children will enjoy frolicking in the spray from the sprinkler while the pool is being filled. When the sprinkler head is not used, it is removed and the drain stopped with a pipe plug, Fig. 2. The sprinkler feature is practical only if the drainpipe outlet is easily accessible for attaching a hose. Galvanized sheet metal or heavy linoleum makes ideal forms for a circular pool. Fig. 7 shows how stakes and cross braces are used to support metal forms. As a safety precaution, do not make the depth of the pool at the center more than 12 in.

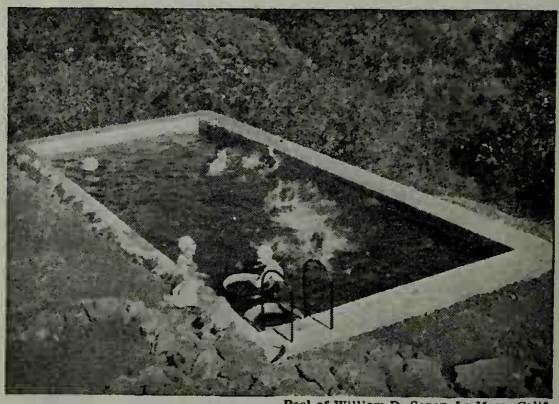
Fig. 6 details a pool of unusual construction which is suitable for youngsters learning to swim. However, it is not desirable in regions where winter temperatures drop below freezing as the 2-in. walls will not withstand movement of the ground due to frost. The excavation for this pool is furred with strips nailed to stakes driven into the earth walls. Then metal lath is stapled to the furring strips and poultry wire is used in the bottom for reinforcement. Walls are plastered with cement and the



Here is an example of how a pool built on sloping ground reduces the job of excavating. Double-formed, pool is ready to be poured

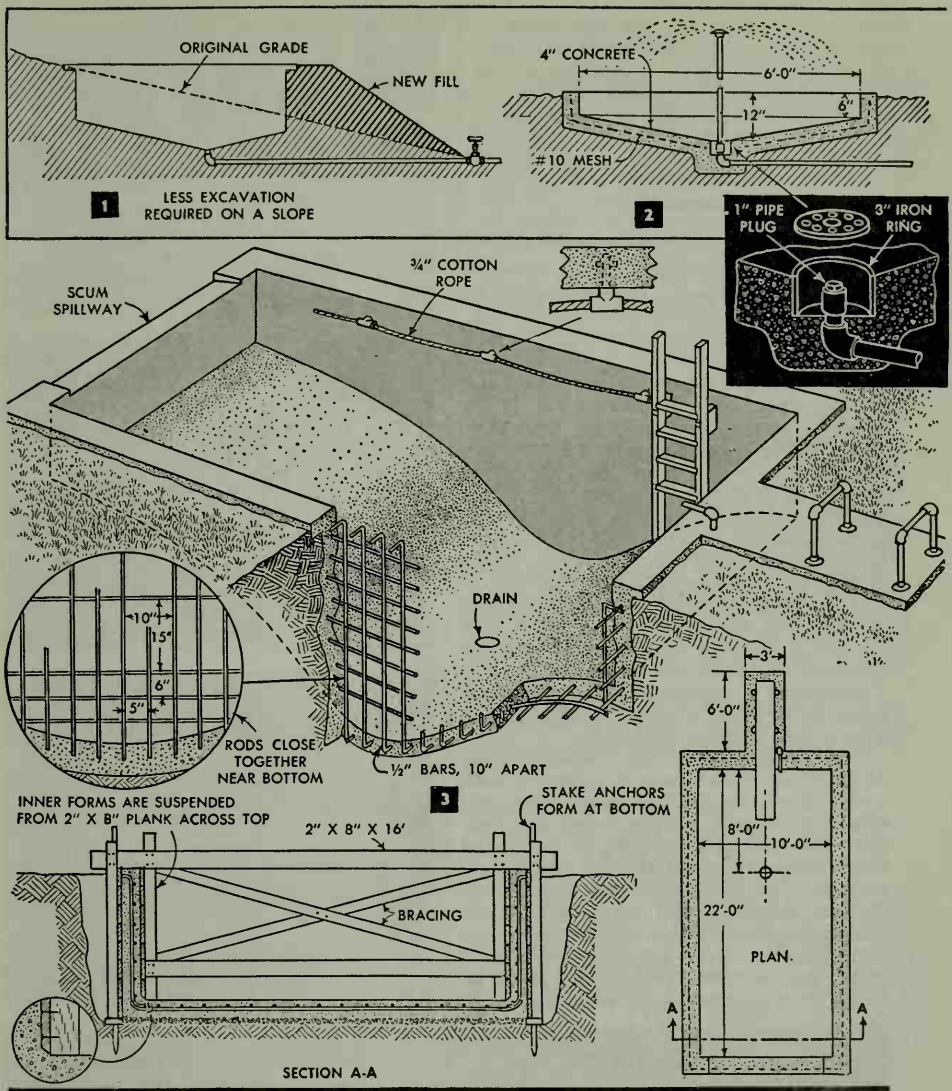


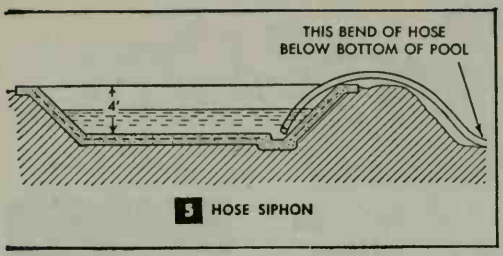
This view shows the pool poured, the forms removed and drain installed. Walls take less concrete when bottom of pool is sloped



Pool of William D. Soper, La Mesa, Calif.

Finished pool in use. Drainage is no problem of pool similarly situated. Here, drain in side carries water off for irrigation purposes. Note metal ladder which is embedded in concrete at time of pouring


ORIGINAL GRADE
NEW FILL
1
LESS EXCAVATION REQUIRED ON A SLOPE
4" CONCRETE
6'-0"
12"
6"
#10 MESH
2
1" PIPE PLUG
3" IRON RING
SCUM SPILLWAY
¾" COTTON ROPE
DRAIN
10"
15"
6"
5"
RODS CLOSE TOGETHER NEAR BOTTOM
½" BARS, 10" APART
3
3'
6'-0"
8'-0"
10'-0"
22'-0"
PLAN.
A
A
INNER FORMS ARE SUSPENDED FROM 2" X 8" PLANK ACROSS TOP
2" X 8" X 16'
STAKE ANCHORS FORM AT BOTTOM
BRACING
SECTION A-A
WIRE BARS TOGETHER
WIRED
AVOID POCKETS LIKE THIS
CORNER LOCKING
A
PACKING DIRT AFTER REMOVING FORM
B
RECOMMENDED CONSTRUCTION FOR VERY LARGE POOLS
C
CRUSHED STONE
10"
12"
24"
D
4

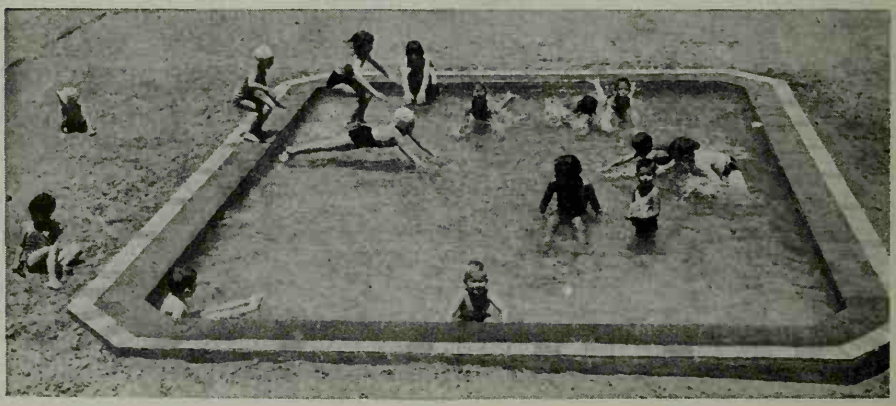


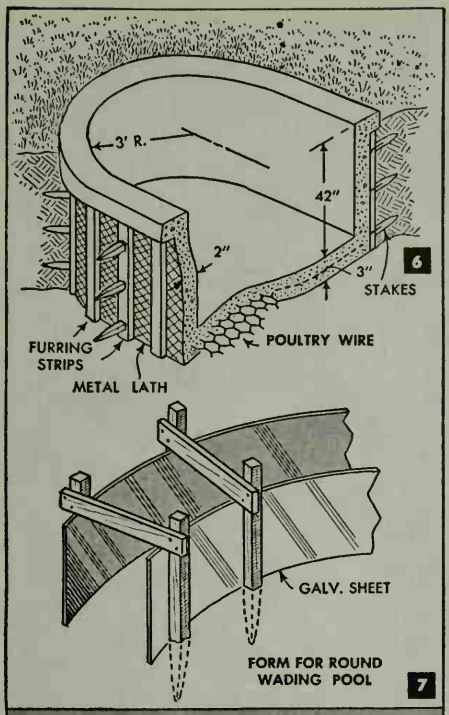
5 HOSE SIPHON

bottom is covered with a 3-in. layer of concrete poured over a 4-in. bed of gravel and strengthened with the wire. Finally, a reinforced curbing or parapet is laid around the edge.

An inexpensive pool without plumbing is shown in Fig. 5. Measuring 12 by 20 ft., it is designed for high ground to eliminate drainage piping and has sloping walls to do away with the need for forms. Bottom and sides of the excavation are tamped well and then 2 in. of concrete is poured over the bottom. This is reinforced with 6-in. spot-welded wire mesh, on top of which an additional 2-in. layer of concrete is poured. When the bottom is firm but still soft, the walls are plastered with cement to form an integral mass which is troweled into a parapet all around the top. The bottom is troweled to slope toward a sump from which the water is siphoned with a hose to drain the pool.

Figs. 3 and 11 detail an adult-size pool, 10 by 22 ft. Note that it is complete with water filter, centrifugal pump, suction-cleaning facilities, diving board and ladder. The deep portion just off the diving board slopes upward at each end to cut material cost. However, don't skimp on the wall thickness and the reinforcement. A minimum wall thickness of 6 in. is recommended for mild climates. Pools built in regions of severe cold should be 10 in. thick to avoid cracking. Section A-A of





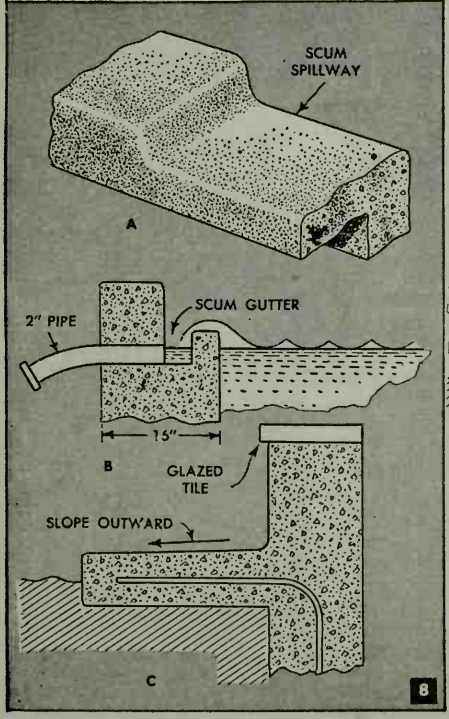


Fig. 3 shows how the pool is double-formed —with inside and outside forms, and how it is reinforced. Note that the inner forms are suspended from crossbeams and that stakes are used to prevent the outer forms from giving way at the bottom. Rods reinforcing the walls and bottom are wired together at the lower corner as shown in Fig. 4, detail A. The walls of large pools generally are poured on footings and a separate slab poured for the bottom, much like the foundation of a house. Then a mastic is run in the joint to make it watertight as shown in Fig. 4, detail D.

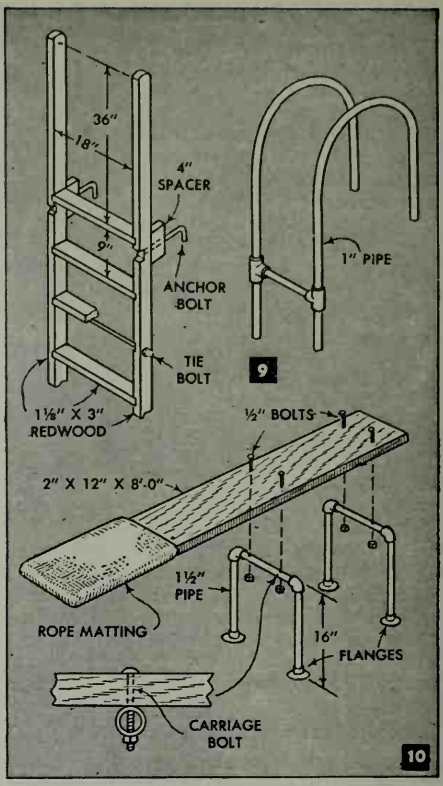
Figs. 9 and 10 give suggestions for making ladders of pipe or wood, and also plans for a springboard. The metal ladder should be of galvanized or stainless steel and embedded in the concrete at the time it is poured. Spruce is the best material for the springboard. Bevel the edges and cover the end with a nonslip padding of rope matting.

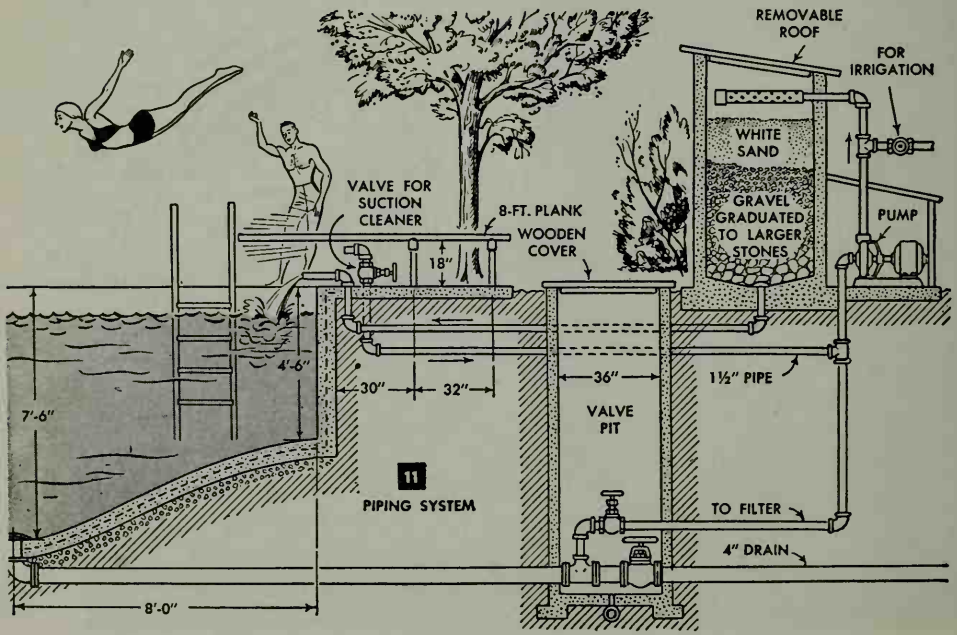
Three types of parapets are shown in Fig. 8. Parapets A and B incorporate a spillway in the top of the wall for floating off leaves and litter by raising the water level. In the case of B, drainpipes are spaced about 8 ft. apart all around the pool. Detail C shows construction of a parapet which extends above ground to provide a low seat around the pool and keeps debris from blowing into the water.

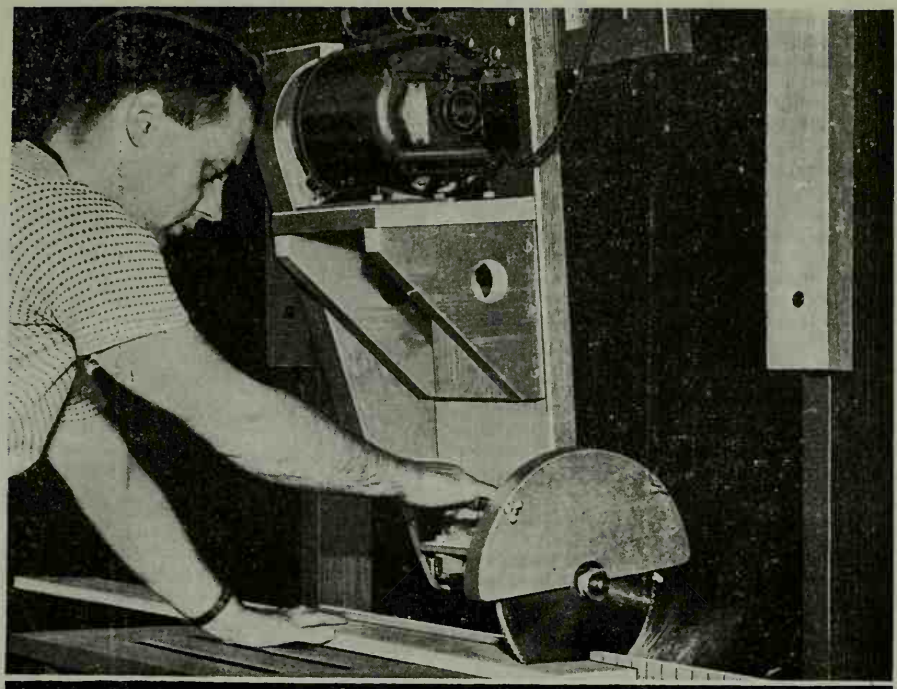
The concrete for small wading pools can be mixed in a wheelbarrow, but for large pools it is best to rent a small power mixer.

A recommended proportionate mix consists of portland cement, 1 part; sand, 2½ parts; and gravel, 3¼ parts. If the pool is to be plastered, the proportions should be as follows: portland cement, 1 part; and sand, 3 parts. Six gallons of water per sack of cement is about right. It is always best to pour a job complete at one time, but if this cannot be done, the joint should be roughened to assure a good bond and brushed with a soupy mixture of cement and water just before the pouring is resumed. Be sure that the concrete is well spaded in the forms with a long pole, to prevent air pockets and porous places in the finished wall. Also, avoid cave-in areas in the dirt walls, Fig. 4, detail B, which take considerably more concrete. Forms should not be removed for two or three days, after which the concrete should be cured gradually by wetting it frequently for several days. Dirt fill around the outside of the walls is packed solidly by wetting with a hose as it is shoveled in place, Fig. 4, detail C.

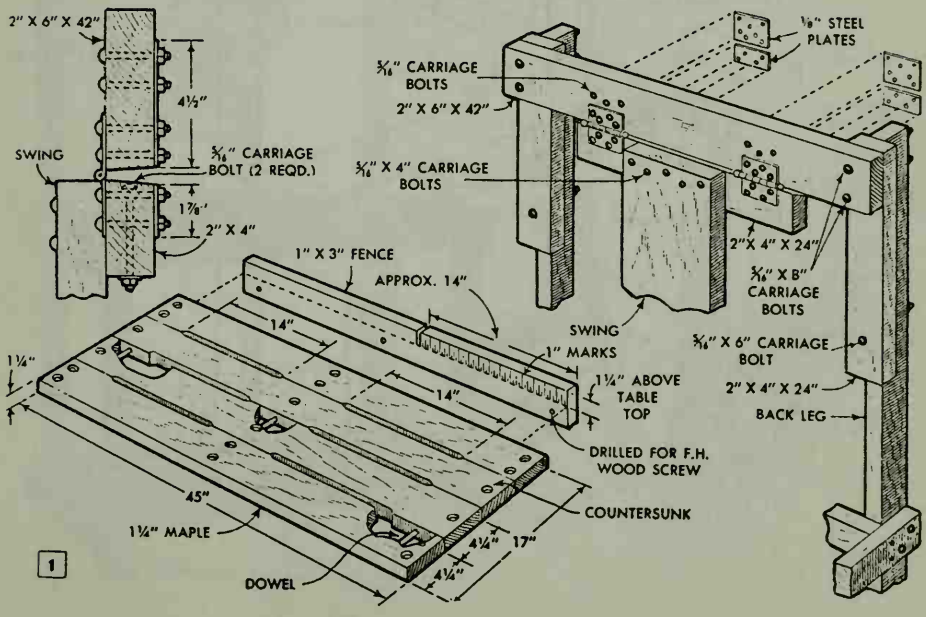
The nozzle from an old vacuum cleaner attached to a long pole will be found handy for cleaning the walls and bottom of a pool. Fasten it to a length of large hose and connect it to the suction-pump inlet, Fig. 11. Finish the walls and bottom of the pool with a couple coats of rubber-base paint. When cracks develop which cause serious leakage, they can be filled with asbestos roofing cement and then painted.







SWING SAW


2" X 6" X 42"
4½"
SWING
⅝" CARRIAGE BOLT (2 REQD.)
1⅞"
2" X 4"
1" X 3" FENCE
APPROX. 14"
14"
14"
1" MARKS
1¼" ABOVE TABLE TOP
1¼"
DRILLED FOR F.H. WOOD SCREW
COUNTERSUNK
45"
1¼" MAPLE
4¼"
17"
4¼"
DOWEL
⅜" CARRIAGE BOLTS
2" X 6" X 42"
⅜" X 4" CARRIAGE BOLTS
⅛" STEEL PLATES
2" X 4" X 24"
⅝" X 8" CARRIAGE BOLTS
SWING
⅝" X 6" CARRIAGE BOLT
2" X 4" X 24"
BACK LEG

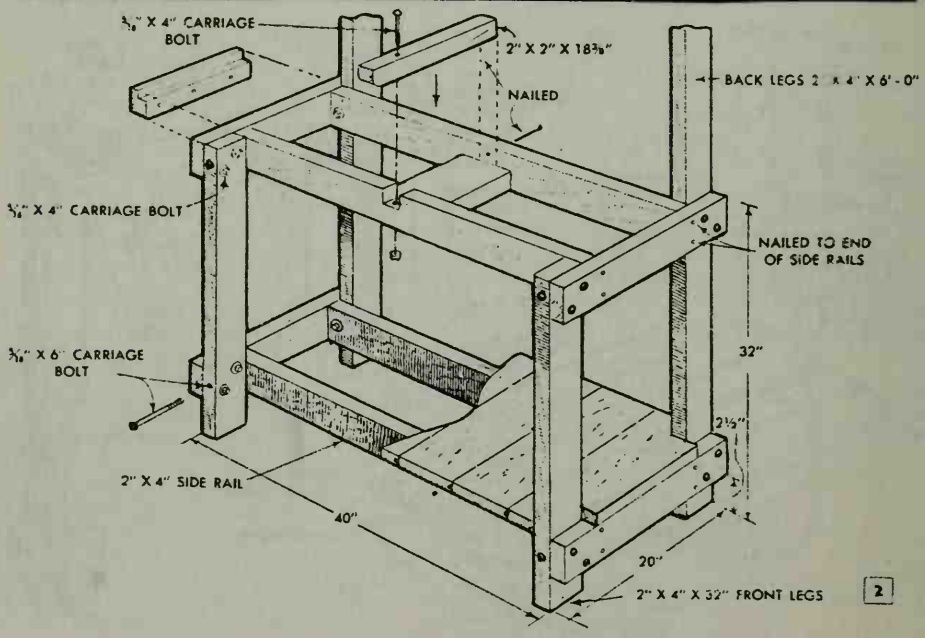
1

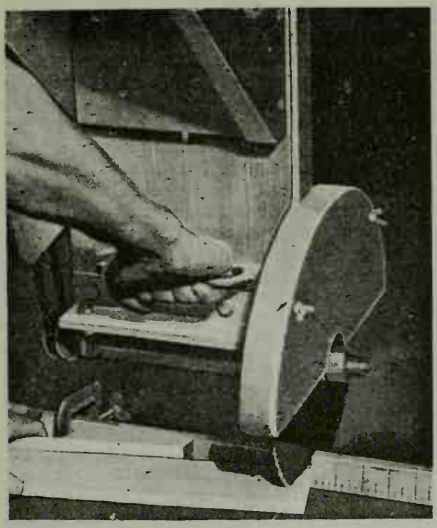
FOR CROSSCUTTING long boards and framing lumber to precise lengths, you can't beat a swing saw for speed and accuracy. That's why experienced home craftsmen, cabinetmakers and carpenters usually build one for use in the shop. The principal units and parts you'll need for the job are a ½-hp. motor, a ball-bearing saw arbor of the type having a housing cast with bolt lugs, suitable pulleys and belt, a pair of heavy butt hinges and a few straight 2 x 4s and 2 x 6s with which to build the table frame and the back support. Figs. 1 and 2 detail the saw table and frame. Before cutting the stock, note that the table height will be 32 in. plus 1¼ in., the thickness of the table top, or, a total height of 33¼ in. Some craftsmen prefer a table height of 36 in. on a swing saw. Check beforehand to make sure which table height you desire. Note also that the table-top length is 45 in. and that the saw blade is on the operator's right. Many craftsmen prefer the blade on the left, as it is somewhat easier to see the dimension marks when cutting to pencil lines rather than using the scale on the table fence. This will require a saw arbor with a left-hand thread.

The back legs of the table extend to 6 ft. in height as in Fig. 2. First, cut the legs and the end and side rails, or stretchers. Be sure that all parts are cut square at the ends and to the lengths specified. Assemble the end members with glue and bolts as in Fig. 2 and check both assemblies for squareness before the glue dries. Then set up the frame with the side rails in place and place bar clamps across the top and bottom end rails, using one clamp at each corner so that the frame can be drawn together tightly before drilling the holes for the 6-in. carriage bolts. Use waterproof glue in the joints and, when the frame has been glued, clamped and bolted, check for squareness.

The table top, Fig. 1, is a simple edge-gluing job with the joints doweled. To form the slots, bandsaw both edges of each of the inner pieces, and one edge of each of the outer pieces to a depth of ½ in., each cut being 14 in. long. Start the cuts in on a ½-in. radius, run straight for 13 in., then out to the edge on a ½-in. radius. When the table strips are assembled, the cuts will form 1-in.-wide slots with rounded ends, permitting sawdust and chips to fall through to the floor. Although the table length is given

for Your Home Workshop

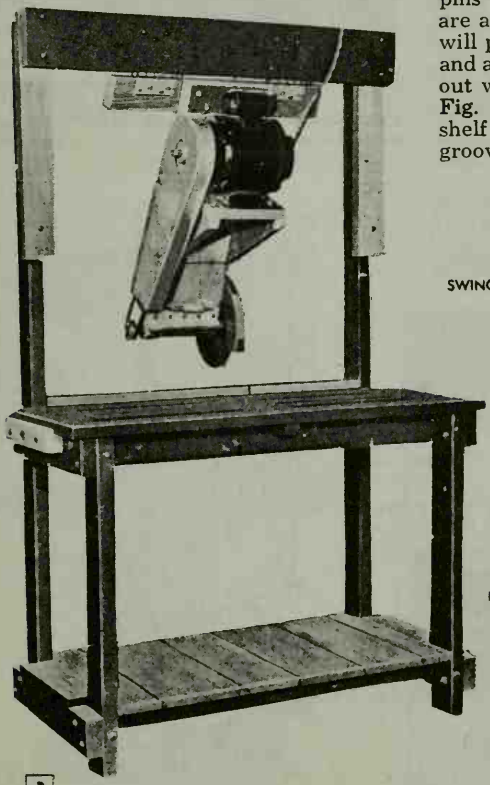


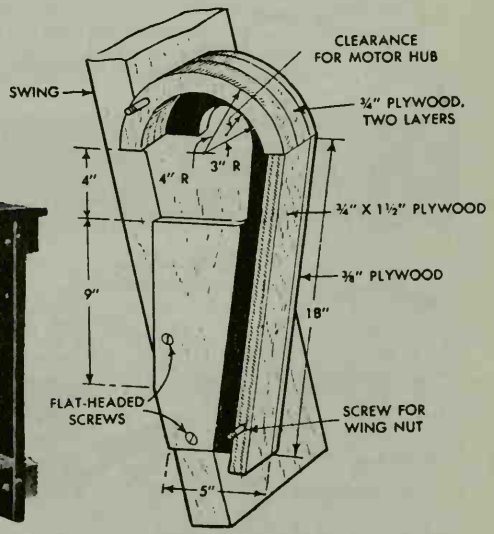


By using angle blocks clamped against the fence, you can make angle cuts up to 45 deg. on narrow stock

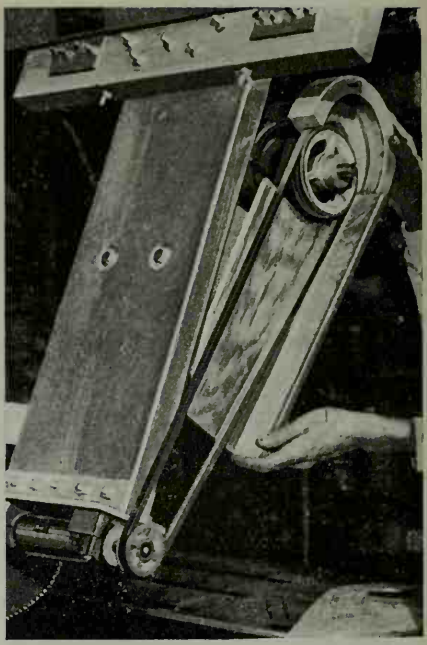
here as 45 in., it can be made any convenient length up to 6 ft. by using the same general construction and thickness of material. The table top is attached to the frame with spaced wood screws driven in countersunk holes. If desired, the holes can be filled with wooden plugs after driving the screws. Note in Fig. 2 that the table top is supported at the center by a 2 x 2-in. cross member bearing on a 2 x 6-in. spreader glued between the rails. The cross member is notched through the front rail as shown. Sand the table top smooth and apply a thin coat of orange shellac. Finish with wax. The lower shelf, Fig. 2, can be omitted if desired.

The swinging column, motor shelf, guard and arbor mounting are detailed and pictured in Figs. 3 and 4. The top of the swinging column is attached to a cross member, and this is hinged to the horizontal support which is bolted to the top ends of the back table legs as in Fig. 1. Before attaching the hinges, cut out and drill backing plates from $\frac{1}{8}$-in. flat steel so that the hinges can be attached with bolts as in the sectional view, Fig. 1. Lay the hinges on an anvil and indent the hinge eyes with a prick punch so that the pins will be a tight press fit when the hinges are assembled with the parts in place. This will prevent any play in the swinging arm and also will prevent the pins from working out while the saw is in operation. Note in Fig. 4, right-hand detail, that the motor shelf rides on a key, or guide, fitting in a groove cut on the back face and that the bolt



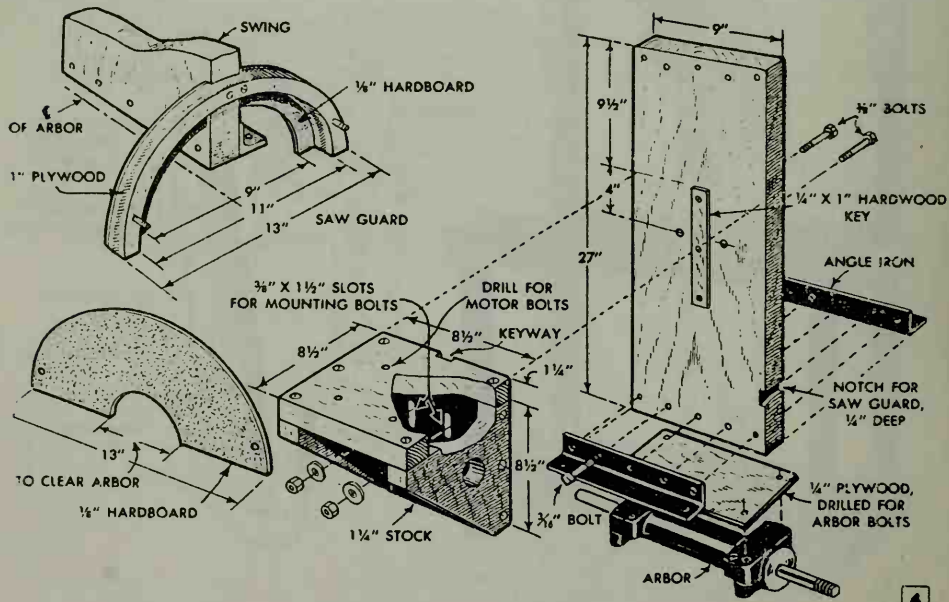


holes are elongated so that the motor may be adjusted to give the correct belt tension. Two pieces of angle iron are bolted to opposite sides of the column at the lower end to form a mounting pad for the saw arbor. Because of slight irregularities of the cast arbor housing, it's a good idea to insert a piece of ¼-in. plywood between the arbor and the angle-iron pad as in the right-hand detail, Fig. 4. It is essential that the saw arbor and motor shaft be as nearly parallel as it is possible to make them. As dimensioned, the parts accommodate an 8-in. blade. After mounting the motor and arbor, make the belt and blade guard, following the details in Figs. 3 and 4. Now, mount the swing unit in the frame and locate at the proper height in relation to the table top by adjusting the supporting cross member of the frame slightly up or down. When properly adjusted for height the blade will cut a groove in the table top about ⅛ in. deep. Screw the fence in place and make this first cut through the fence and across the table top. Then remove the fence and mark it in ⅛ or 1/16-in. graduations to the right of the saw cut. Note in the right-hand detail in Fig. 1 that the swing support is blocked out from the uprights. These blocks are not necessary for cutting stock up to 10 in. wide, but for full capacity of about 13 in. they will move the unit forward just the right distance. For correct blade speed with a 1725-r.p.m. motor, use a 5-in. pulley on the motor and a 2-in. pulley on the arbor.



Belt guard is built up as a unit before attaching to swinging column. Note relative size of pulleys

Details below show the construction of column and angle-iron pad on which the saw arbor is mounted



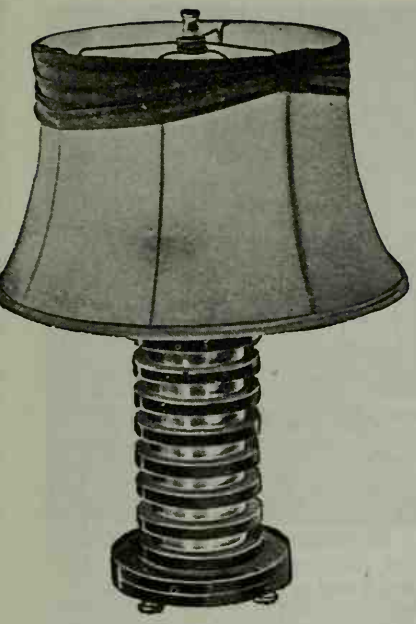
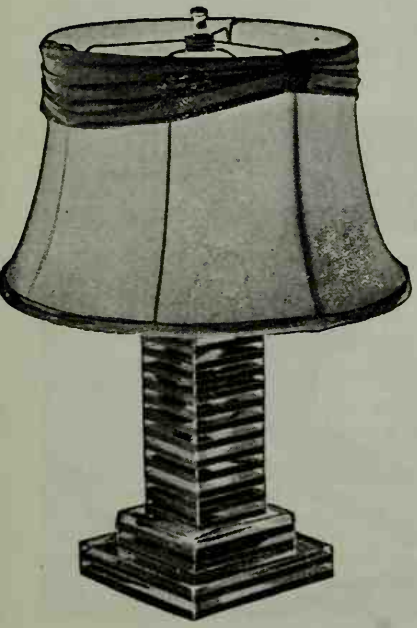
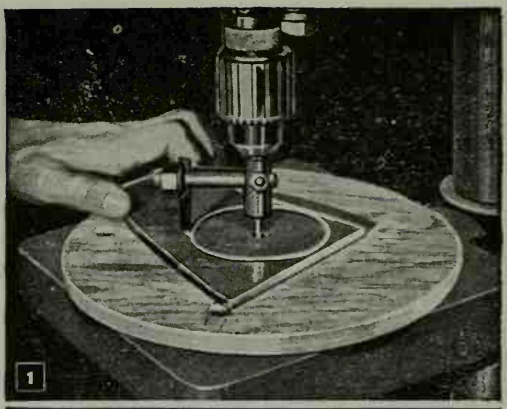


TABLE LAMP

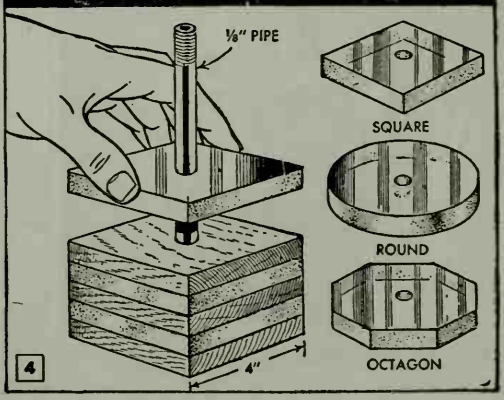


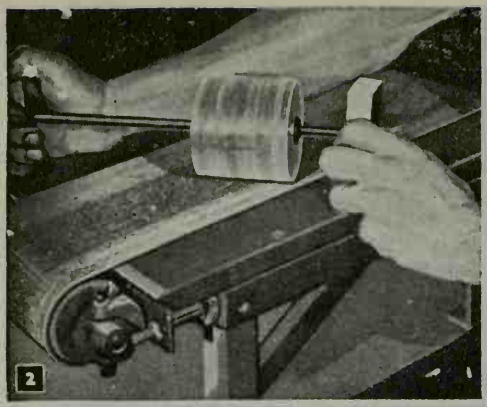


A fast way to cut spacer disks from sheet plastic is to use a circle cutter in a drill-press chuck. Uniformity is had, and, a cutter having a pilot bit of proper size, will form pipe hole at same time

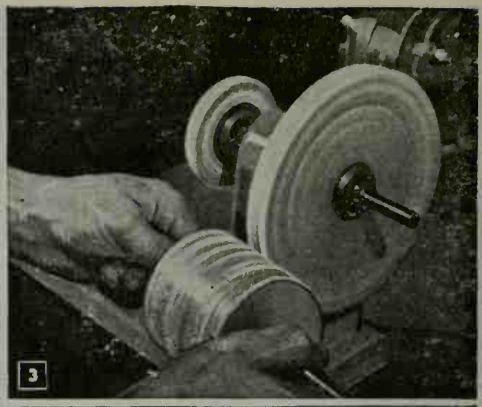
THOSE CHOICE BLOCKS of fancy wood that you have been saving from other jobs will do nicely in combining wood with plastic to make attractive "laminated" lamp bases at very little cost. Layers of aluminum, interspaced with layers of plastic, can be used, or all three materials, plastic, wood and metal may be combined to produce unusual and distinctive bases. Size, shape and thickness of the laminations make the number of variations almost endless. You can cut them square, all the same size, or, every other one can be made smaller to serve as spacers between the

"Disks" may be round, square or octagonal, of plastic, metal or wood. Aluminum or brass spacers combined with clear or colored plastic, or laminations of fancy wood, make attractive bases





Sanding rough edges of the disks on a belt is done at one time by mounting disks on a pipe shaft, letting the shaft rotate in wood blocks as shown. Same setup could be held in lathe to dress edges

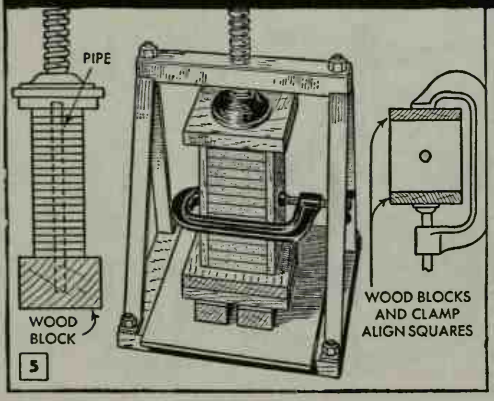


Polishing is done while disks are still on shaft. Cloth buffing wheel, charged with rouge and rotating at high speed, produces high luster quickly. Keep work moving across wheel to prevent "burning" plastic

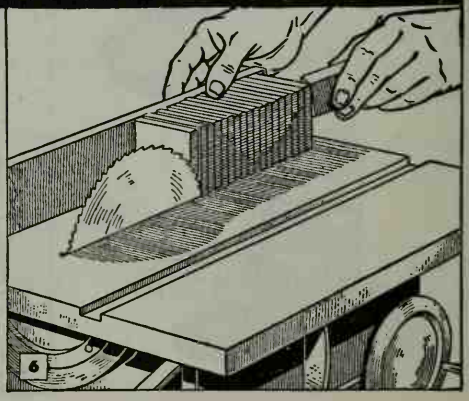
plastic. The same applies to bases built up of disks. Variety also is achieved by using, alternately, layers of clear and colored plastic. Still another variation is had by combining thick and thin layers of two different materials as shown in Fig. 8. Here, for economy, the plastic layers should be kept thin as the cost of plastic in thick sheets is somewhat expensive, especially in ¾ and 1-in. sizes.

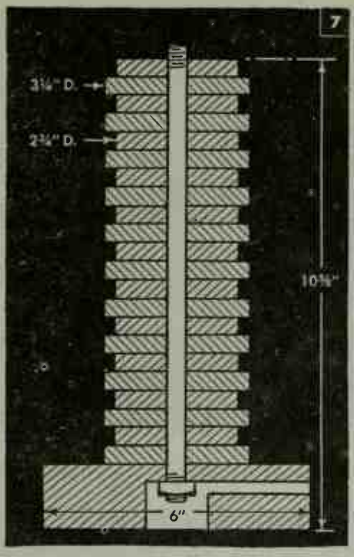
Figs. 1 to 3 inclusive show progressive steps in mass-producing disk-shape laminations of plastic. Those of one size are cut, drilled and grouped together on a shaft for final finishing all at one time. Assembly of the lamp bases is shown in Figs. 4 and 7 and is typical in building up each base regardless of design. Essentially, the layers, whether round, square or octagon shaped, are coated with cement and slipped over a length of electrical fixture pipe and then clamped. A strong cement for bonding plastic to plastic or plastic to wood and metal is made by mixing ethylene dichloride (available at most paint stores) with fine shavings of clear plastic to a consistency of thick syrup. Do not use until the mixture is entirely dissolved and clear. Pour some of the cement into a shallow container, such as a

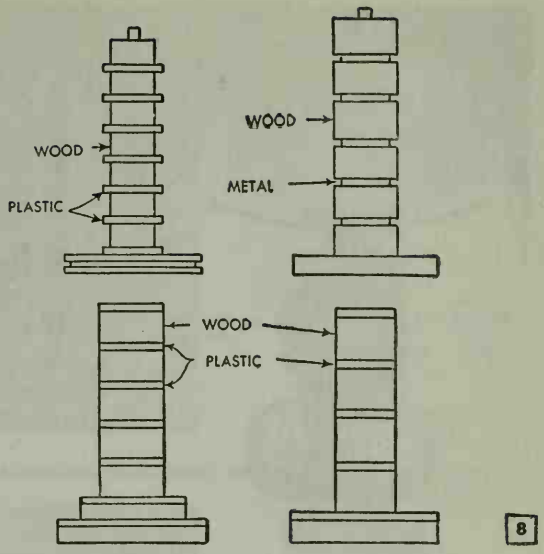
In assembling square or octagon shapes, edges of the layers are aligned and kept flush by clamping blocks temporarily to opposite sides. Veneer press provides even pressure, but C-clamp can be used



Any unevenness too great to remove by hand sanding can be trimmed flush with a power saw, provided the work is not too large. Use a fine blade and pass the work slowly to prevent chipping plastic laminations





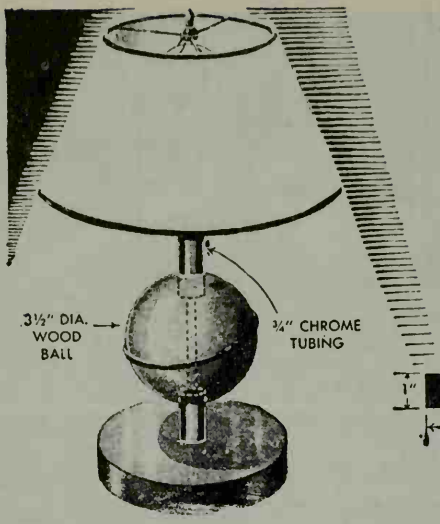


saucer, and coat the surface of each lamination by dipping it into the cement. Work fairly fast as the cement has a tendency to dry quickly. In clamping the assembly, apply sufficient pressure to eliminate air bubbles, but avoid squeezing out all of the cement. A veneer or paper press is ideal to provide uniform pressure, but you can use a couple of large C-clamps. In clamping square-shaped laminations, the setup shown in Fig. 5 should be used to align the edges. Remove the wooden guide pieces before the cement sets, however. Any unevenness too great to remove by hand sanding can be trimmed flush with a fine saw blade or a cutoff wheel as in Fig. 6. The base piece of the lamp is drilled according to the sectional view in Fig. 7 for the lamp cord. Then the two parts of the base are held together by a washer and nut fitted to the end of the pipe.

A word about sanding and polishing plastics: Sawed edges of the material must be sanded perfectly smooth and all tool marks removed. If a lathe is available, the edges of disks can be trued and sanded glass-smooth by mounting them on a shaft and chucking between centers. A cloth buffer is used to polish plastic by holding it against a wheel charged with rouge.

Small Table Lamps Easily Modernized to Give Soft Indirect Light

Small table and boudoir lamps can be converted easily to the more modern hurricane lamps which give an indirect light, by fitting them with a glass shade taken from an old-type chandelier. If the lamp has a harp-type shade holder, this is discarded because, if a cloth shade is used in addition to the glass one, the cloth shade simply rests on the top of the latter. The glass shade is attached to the lamp socket in an inverted position, as shown, using a standard metal shade holder, which also can be taken from the chandelier. The socket on the lamp must be the type that has threads for screwing on the holder.



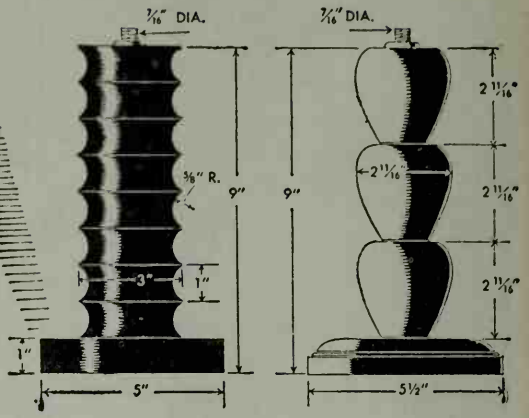
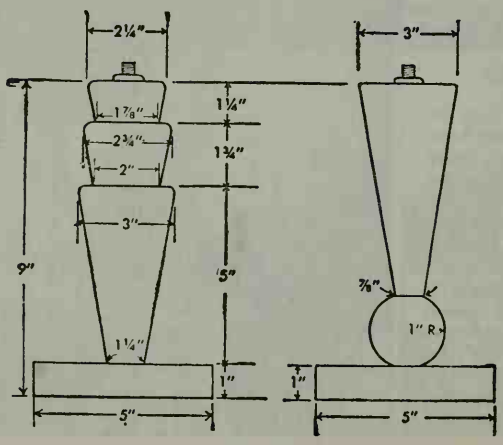
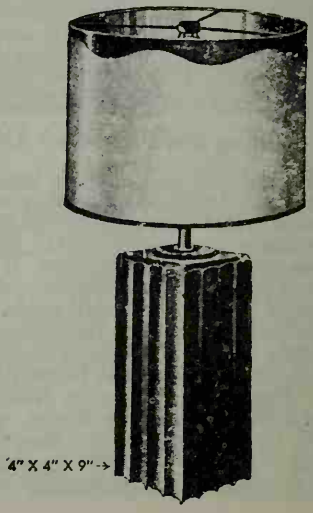
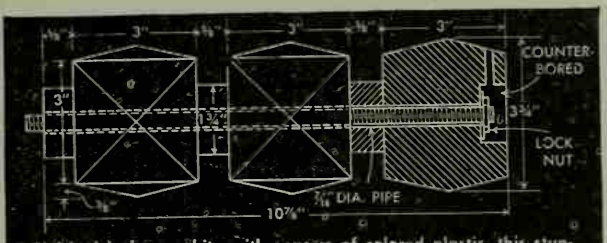


TABLE LAMP

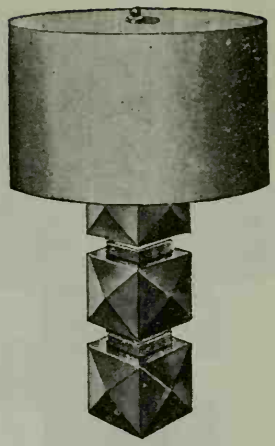
IF YOU'RE a woodturner at heart, here's a chance to make the chips fly. Take your choice of 5 little table lamps that can be made of scraps of fancy wood, plastic, or both, some being made and finished completely in a lathe. With the exception of the fluted lamp below, the component parts of all lamps are "tied" together by a ⅛-in. fixture pipe. The fluted lamp consists of a solid block, counterbored at top and bottom for locknuts, the top nut being concealed by a brass washer. The pipe extending above the base is encased in a ⅜-in. tube and the socket is screwed tightly against it. A hole is drilled through the side of the base for a lamp cord. If necessary, the fluting on the base can be done by hand, using a ¾-in. gouge and then sanding smoothly with a round-nose block.

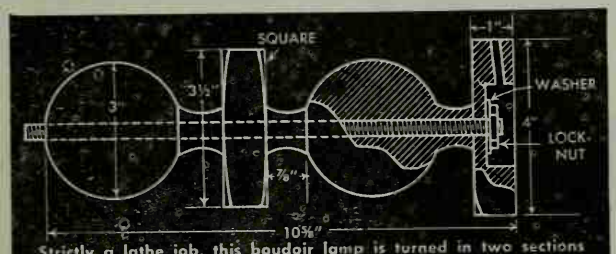




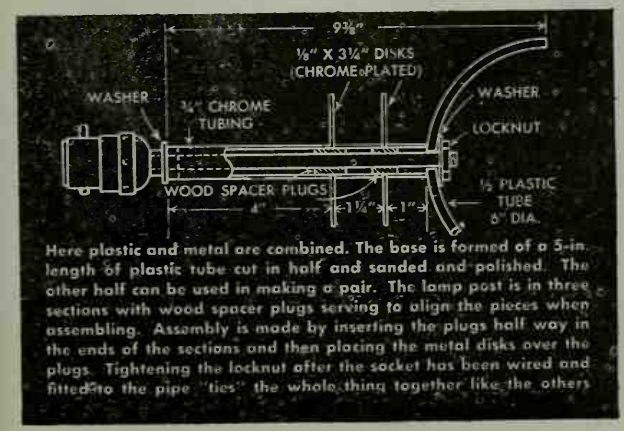


Finished in bone white with spacers of colored plastic, this stunning table lamp takes on a classic-modern appearance. The blocks are shaped identically and drilled through the center for a length of pipe. The bottom block is counterbored for a washer and locknut and then drilled through the side for a lamp cord. With a socket screwed to the top, the whole lamp is held together by the locknut. The diamond effect on the faces of the blocks can be shaped quickly on a disk sander, or the faces may be left plain. The lamp base should be covered with felt or rubber to prevent marring

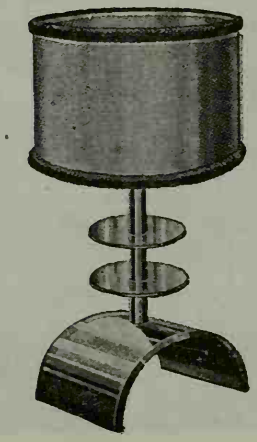




Strictly a lathe job, this boudoir lamp is turned in two sections and later connected by a pipe and locknut in the manner previously described. To facilitate centering the pipe hole lengthwise through the pieces, the work can be drilled beforehand, the holes plugged and the work then mounted in the lathe. A cardboard template will be helpful in checking the roundness of the ball turnings and in shaping both alike. Rounding the faces of the square spacer and base of the lamp is done by mounting the pieces on the lathe faceplate. You can counterbore the base at the same time



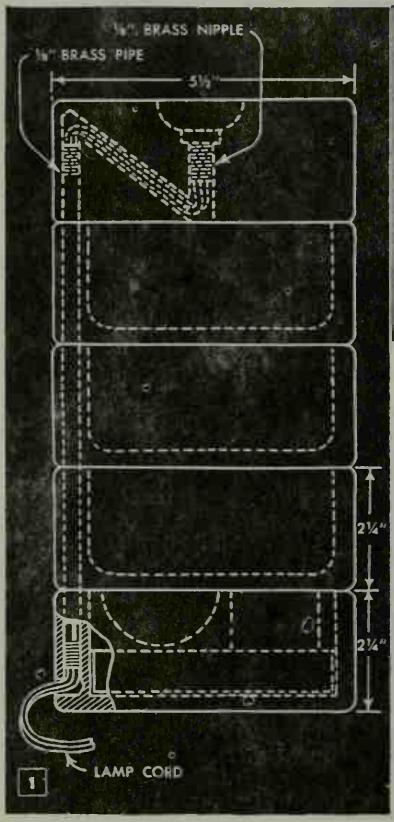
Here plastic and metal are combined. The base is formed of a 5-in. length of plastic tube cut in half and sanded and polished. The other half can be used in making a pair. The lamp post is in three sections with wood spacer plugs serving to align the pieces when assembling. Assembly is made by inserting the plugs half way in the ends of the sections and then placing the metal disks over the plugs. Tightening the locknut after the socket has been wired and fitted to the pipe "ties" the whole thing together like the others

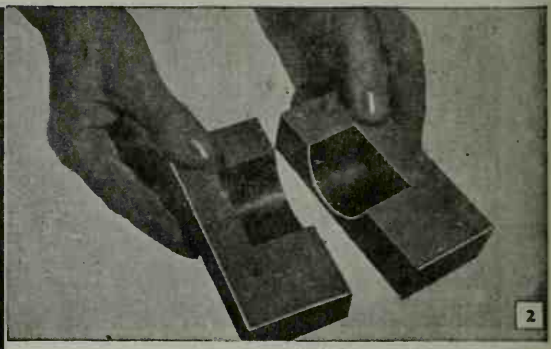


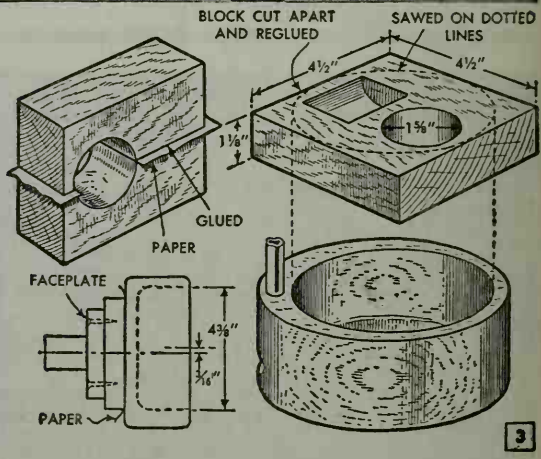
DESIGNED for SMOKERS

TRAYS CLOSED

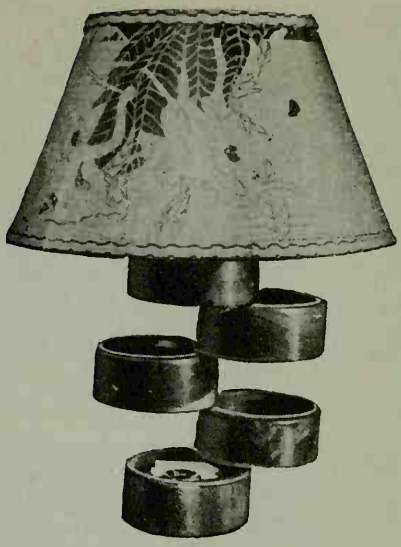
THREE compartments for cigarettes plus an ash tray are all concealed in this attractive hardwood lamp base. When closed, the sections look like a solid wood turning, but swinging the sections to the right or left discloses the compartments for cigarettes and reveals the ash tray in the bottom section. In addition to its usefulness from the smoker's angle, the lamp also provides an excellent hiding place for jewelry and money. Using a good grade of walnut or maple, turn the five sections to an equal outside diameter as shown in the sectional view, Fig. 1. Then round the corners and, while the work is still in the lathe, finish the edges only, by applying a French polish. This is done by dipping a cloth pad in a mixture of sweet oil and shellac and holding the pad against the rotating work. The friction produces a glazed finish which is built up by repeated





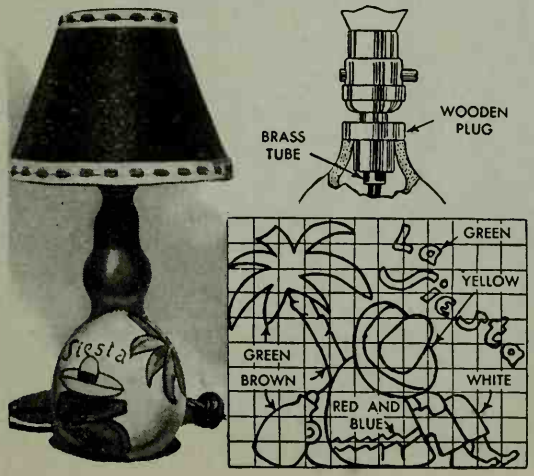


applications. Next, glue a wooden disk to the bottom of each of the four lower sections, sandwiching a sheet of paper between the pieces so the parts can be separated easily. Mount each section for turning by screwing the backing disk to the faceplate 3/16 in. off-center, and then turn the recess to the diameter given in Fig. 3. Recesses in the original trays were turned to a depth of 1⅞ in. but, of course, this can be varied to suit. Note that the recesses in the three center sections are turned with a fillet in the lower corner, but that the corners of the recess in the bottom section are cut square to accommodate a metal ash tray. A wooden cover, having a recess for matches and an opening to the ash tray, fits in the recess in the lower section and rests on top of the ash tray, Fig. 3. Two blocks of hardwood, 1⅛ x 2¼ x 4½ in., are used to make this cover. These blocks are glued together, separated with a sheet of paper, to form a block 2¼ x 2¼ x 4½ in. Then a 1⅜-in. hole is drilled about 1¼ in. deep at least ½ in. in from one edge of the block. This hole must be centered exactly on the joint of the two blocks. The blocks are cut apart along the joint and their edges glued together permanently to form the recess for matches, as shown in Fig. 2. After this, a 1⅝-in. hole is bored through the blocks between the recess and the edge of the cover, and the block is sawed to a disk shape, indicated by the dotted line. If desired, ash tray and cover may be omitted and the lower section merely recessed in the same way as the other three. To hinge the base sections together, drill registering holes through the thickest portions of the



TRAYS OPEN

sides, forming blind counterbored holes slightly undersize in the top and bottom sections, so the threads of a length of ⅛-in. brass pipe will "take" in the wood. To assure perfect alignment of the holes, the three sections should be stacked and drilled at one time, and then one of these sections should be used as a guide to drill the blind holes in the top and bottom sections. Drill a hole for the lamp cord through the side of the bottom section, and drill and recess the top section as shown by the dotted lines in Fig. 1. Assemble the parts and wire the lamp socket, fishing the cord through the slanting hole with a bent wire.



Colorful Table Lamp From Bottle Gourd

A colorful Mexican scene painted on a dried bottle gourd provides an unusual and attractive base for a small table lamp. To make the lamp, cut off the top of the gourd and turn a wooden plug as shown to fit in the neck of the gourd. The shoulder should be flush with the outside. Then drill the plug to take a piece of brass tubing and wire a lamp socket, running the cord through the tubing and a hole drilled near the bottom of the gourd. Weight the gourd with gravel or sand and secure the plug to the neck with adhesive tape. A brightly colored shade completes the lamp.

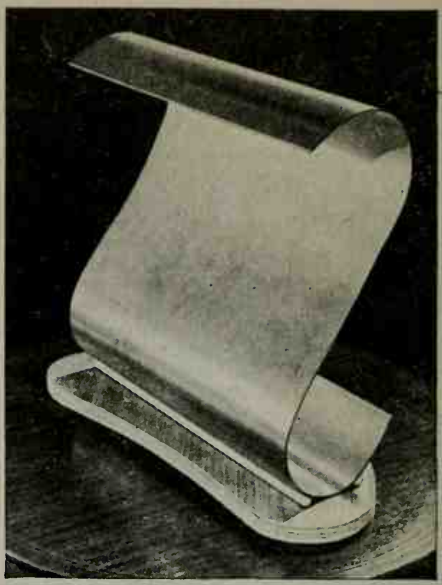
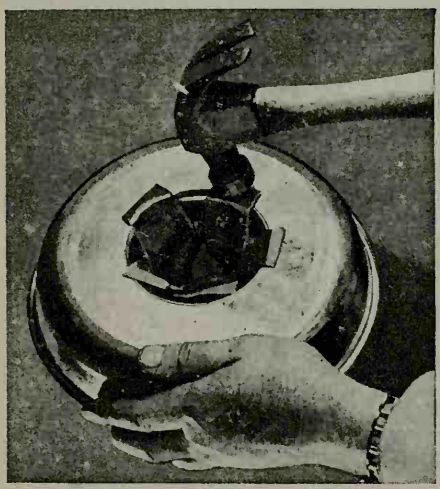


Table LAMPS



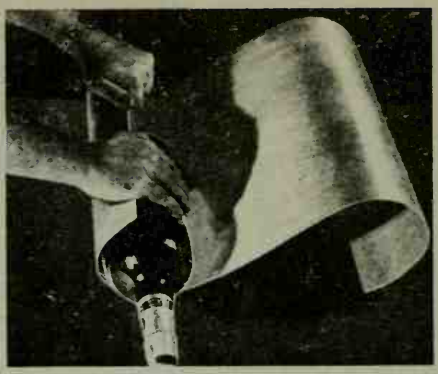
After inserting end of metal roll through baking tin, slit the metal with tin snips and hammer the ends over

TABLE LAMPS like these are available only from your own basement workshop. Although just one of the designs is shown as a planter lamp, both can be readily adapted to this decorative purpose. The reflectors, which are especially styled to go with modern furnishings, should be made from polished aluminum, copper or red brass. In the novel jack-in-the-pulpit design, upper left, the "pulpit" is made from polished copper, a sheet 9 in. wide and 32 in. long being required. "Jack" is a tubular-type filament lamp bulb turned into a keyless socket which is anchored in a plywood base. The latter is cemented to a baking tin of the type used for baking small cakes and for molding salads. The baking tin forms the planter. The first step is to roll the end of the copper sheet in from both edges so that it will slide through the upper end of the conical riser in the center of the tin. Force the rolled end through the riser un-

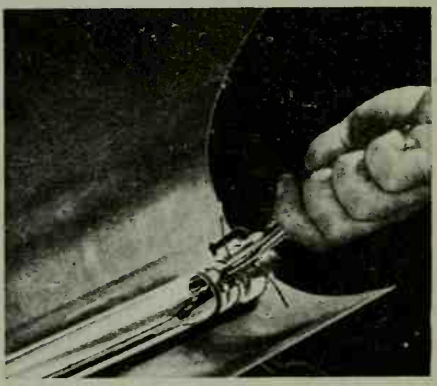
til it projects about 1 in. from the bottom and then make several cuts with tin snips so that the metal can be bent over and hammered flat, as in the photo at the lower left on the preceding page. The other end of the copper sheet is trimmed to a long, tapering point to simulate the single wide leaf of the jack-in-the-pulpit plant. Bend the point over and down as shown in the photo. Next, cut a circular base from ¼-in. plywood to a diameter slightly less than the diameter of the tin. Drill a hole at the center to take a ¾-in. fixture bushing with slotted nut. Turn the nut on the lower end, insert the bushing in the hole and screw the socket onto the upper end. Wire the socket with standard lamp cord and provide a cord switch for turning the lamp off and on. Drive three rubber-headed tacks, equally spaced, into the underside of the plywood base. Now, turn the lamp bulb into the socket and coat the top side of the base with mastic cement as in the lower photo at the right. Insert the lamp bulb through the neck, or riser, at the center of the tin and press the base tightly against the bottom of the pan, being careful to center the bulb. Wipe off excess cement and weight the tin until the cement sets. Coat the tin and the plywood base with a flat-black enamel.

The novel S-shaped reflector, or shade, on the table lamp shown in the upper right-hand photo on the preceding page is made from a single sheet of copper 16 in. wide and 24 in. long. While you can roll the metal around a bottle as in the top photo at the right, you'll get a better job if you have your tinsmith do this on his slip roll. The lamp and socket are housed in the upper curve of the S, which forms the reflector. Although in the original the socket was simply wrapped with a layer of rubber tape and two layers of friction tape and held in place with a twisted wire, a better installation is to rivet a metal angle bracket in the top curve near one end. Drill the bracket to take a brass fixture bushing, insert the bushing through the hole, turn a nut on one end and screw the keyless socket onto the other end. Bring the lamp cord to the socket through a hole drilled in the back of the reflector. Fit a rubber or fiber grommet in the hole to protect the cord and provide a cord switch for controlling the tubular-type filament lamp bulb. Although the base of the original lamp was made from birch plywood, colored plastic also can be used. In either case, the reflector is attached to the base with three screws and supports are placed at each side of the lower curve. These can be polished birch dowel rods or clear plastic rods cemented in place.

Polish the metal reflectors of both lamps on a buffing wheel and apply a clear metal lacquer to prevent tarnishing.



Reflector can be shaped with aid of bottle, but for a better job take it to your tinsmith for forming



Although socket can be wired in place, it is better to support it in an angle bracket and fixture bushing

After fitting socket and lamp bulb, coat the plywood base with cement and attach to bottom of the planter

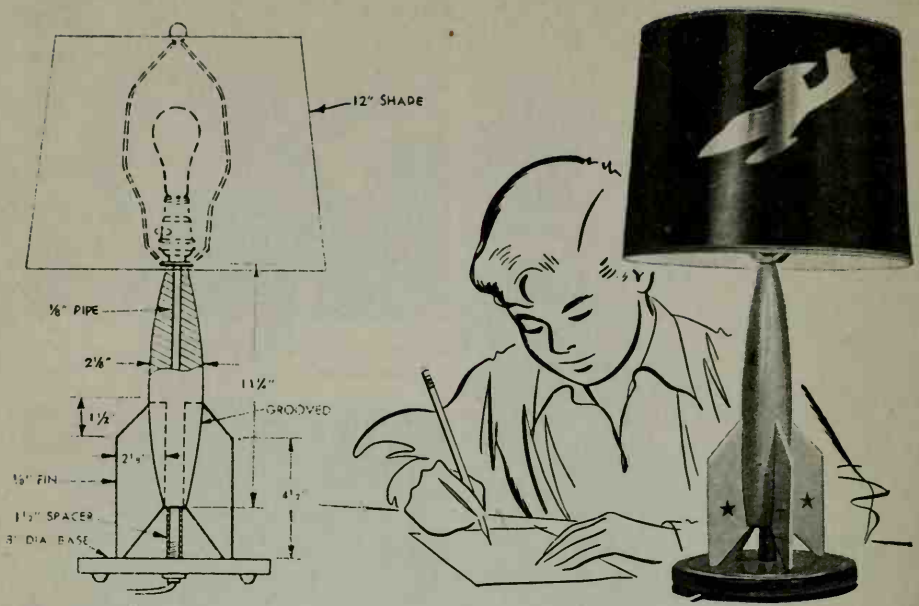
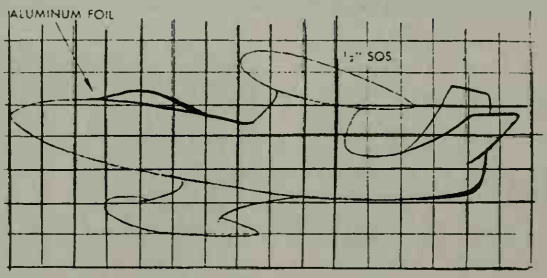


TABLE LAMP



THIS ROCKET desk lamp will have the space-minded youngster beaming with enthusiasm. The rocket-shaped standard is a split hardwood turning, each of the two parts first being grooved lengthwise to take a ⅛-in. fixture pipe. After grooving, the parts are glued together, the ends plugged temporarily and turned to the contours of a rocket hull, following the dimensions given. After turning, the lower end of the rocket is slotted to receive four tail fins of ⅛-in. stock. The fixture pipe inserted through the hull anchors the rocket to a wooden base 8 in. in diameter. Note that a spacer of red plastic or fiber is slipped over the exposed end of the pipe before fastening it to the base. The top end of the pipe is fitted with a standard lamp socket and harp, and a suitable lamp shade is decorated with a jet-plane silhouette cut from aluminum foil. Dark blue is suggested for the base, with light blue for the rocket

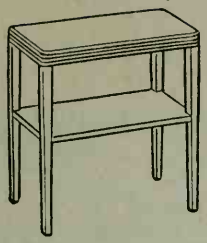
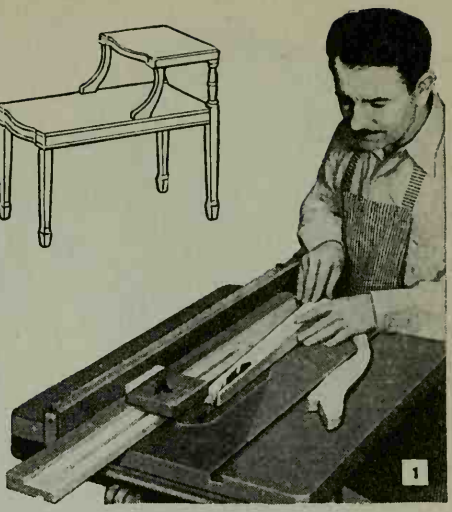


TABLE LEGS

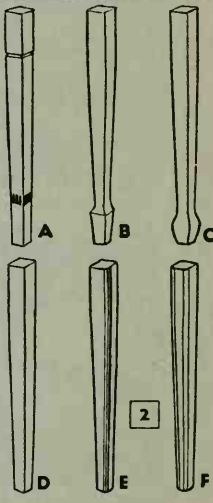
Simple wooden jigs to guide the work make it easy to duplicate tapered legs in quantity with saw, jointer or shaper. Includes straight and spade-foot types

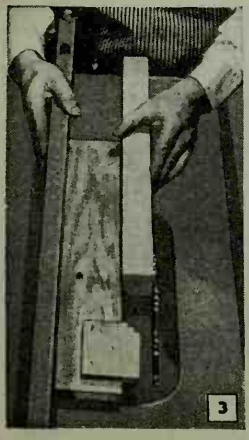


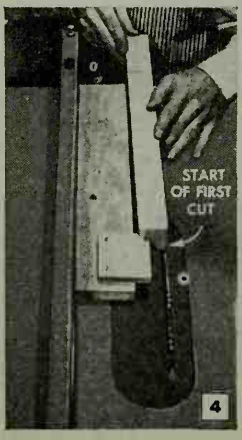
CHARACTERISTIC of the Adam and Hepplewhite influence in period-furniture design, the square tapered leg in any of its variations lends itself to mass-production in the home shop by using a few simple jigs. Power tools are required, but the straight-taper leg can be cut completely on just a circular saw. A shaper or jointer is needed to produce the popular spade-foot leg.

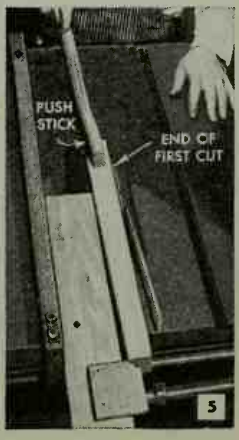
Design variations: Various leg styles are pictured in Fig. 2. Style A is a straight taper with a decorative groove at the top and an inlaid or painted band near the bottom. B shows the spade foot commonly used for period pieces, and C is somewhat similar but with the spade rolled into the taper without a break of line. Leg style D is a straight taper on two sides only, a style often used because it represents less work and the slight splayed effect is quite attractive. E is a straight taper with outside corner rounded, very popular for modern furniture, and F shows another edge treatment, with all edges beveled. In period pieces, the legs often are ornately carved, fluted or inlaid on the show faces, but for modern pieces the only decoration in popular use is the banded style pictured at A.

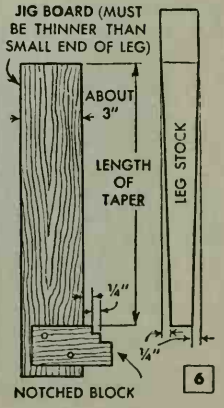
Cutting the straight taper: Whenever practical, the taper should be sawed in preference to jointer and shaper methods. The best

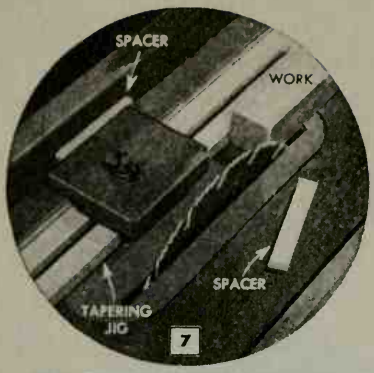


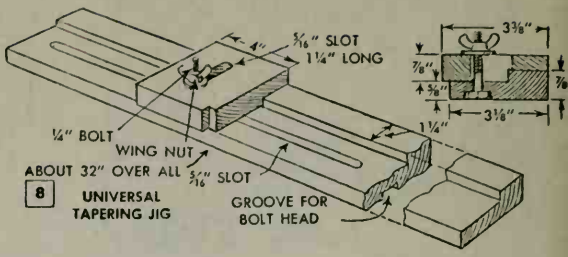


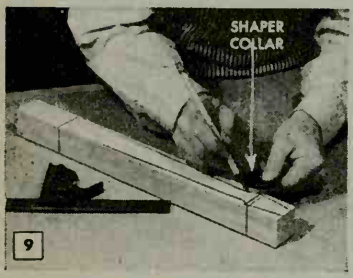




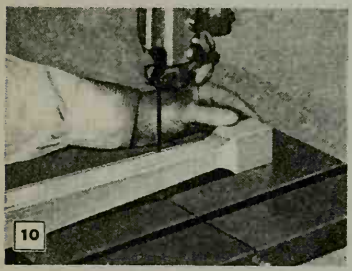








Draw outline of leg in pencil on adjacent faces and use shaper collar to mark curve



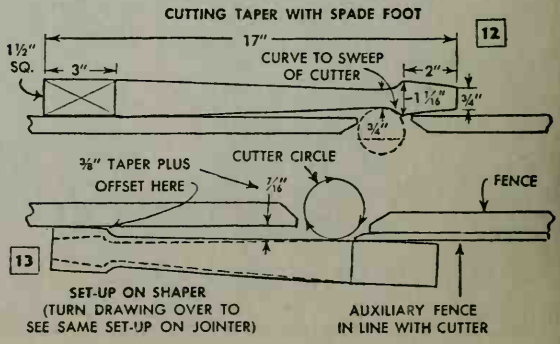
To save wear on the cutting edges of the shaper knife, remove waste wood first

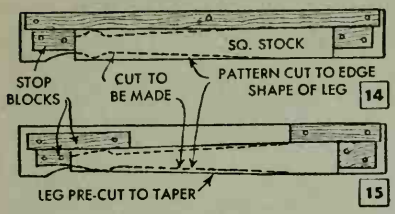
Either a jointer or shaper can be used to cut the taper. Infeed table or fence, as the case may be, is offset a distance equal to the amount of taper you desire

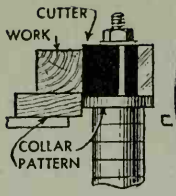
blade to use for this is a combination one, hollow ground, sometimes called a planer saw. Such a blade produces an exceptionally smooth cut, requiring only light sanding. Fig. 6 shows a typical straight-taper leg design, calling for a ¼-in. taper on each face on all four sides. Fig. 6 also shows a simple jig which is used in conjunction with a circular saw. The jig board should be as long as the tapered part of the leg, plus 3 or 4 in. to accommodate the notched block. Notice that the depth of the notches in the block must equal the taper, in this case, ¼ in.

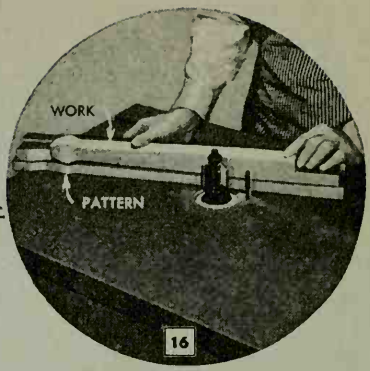
How the jig is used: With work dressed to net size and perfectly square, the saw-fence setting is made to equal the combined width of jig board and work, as shown in Fig. 3. Then the work is placed in the first notch of the jig and pushed into the saw, Fig. 4. Note that feed pressure is on the work, not the jig. The end of the cut is shown in Fig. 5. Two adjacent sides are cut with the work in the first notch. Then, without disturbing the fence setting, the two remaining sides are cut with the work in the second notch. To compensate for the waste removed from two sides, retack a block equal to the thickness of the waste so that the work will ride horizontally in cutting each taper. A push stick must be used for feeding near the end of the cut, Fig. 5.

Universal jig: While the jig board is practical, some workers prefer a more permanent device, such as the one shown in Fig. 8. Here, only one notch is used, the sliding block being arranged so that it can be adjusted to any taper up to ½ in. (about 1⅛-in. taper if the cut is made on one side only). This jig is set with spacing blocks placed between the jig and



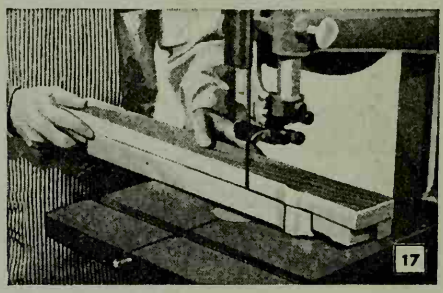




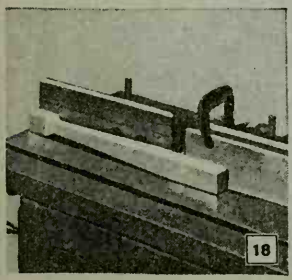


saw fence. In the example shown in Fig. 6, the spacer blocks would be ¼ in. thick. The saw-fence setting is made as before. Offsetting the block for the first cuts is made with one spacer block, as shown in Fig. 7. The final cuts are set with two spacer blocks as in Fig. 1.

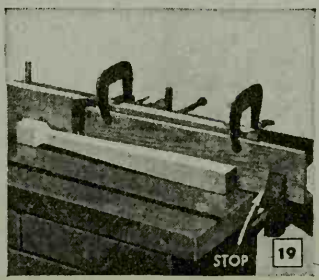
The spade foot: It is not possible to make the long taper of this style of leg on a circular saw, hence the cut must be made by a jointer or shaper. Start by laying out the shape of the leg for a master pattern, Fig. 12, and make the curve at the bottom equal the radius of the shaper collar or jointer cutterhead, Fig. 9. Rough-bandsaw some of the surplus wood on all four sides, but leave the spade portion at full thickness, Fig. 10. Next, set up the shaper or jointer for tapering. This setup requires that the infeed table or fence must be offset from the cutter a distance equal to the taper desired, in this case, ⅜ in., Fig. 11. Also, because the shape of the leg holds the work out from the fence, as shown in Fig. 13, this extra distance must be added to the offset. The out-feed end of the shaper fence is fitted with an auxiliary fence and this should be pushed up as close to the cutterhead as possible in order to minimize the slight bite at the beginning of the cut. The out-feed fence of the shaper or the jointer table must be exactly in line with the cutting circle of the knives. Fig. 18



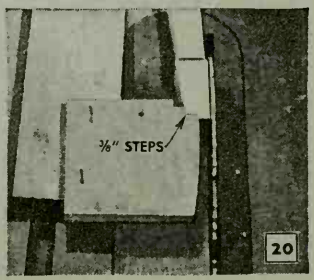
shows the start of the cut and Fig. 19 shows the cut near completion. All four sides are run with the same setup. The short taper comprising the foot is sawed with a modification of the step-block idea. The taper required is ⅜ in. on each side, hence the step-block has ⅜-in. steps. The proper position of the work in relation to the saw for the first cut is obtained by using a straightedge across the saw blade, aligning the pencil mark on the leg with the straightedge. Then the step block is nailed to the jig board at this setting. The first pair of adjacent sides is cut as before with the work in the first notch; the remaining pair requires that the work nest in the second notch, Fig. 20, to cut the taper.



Auxiliary fence minimizes slight "bite" of cutter at start of cut



Here taper cut is nearing completion. Note use of handscrew as a stop block



Taper of foot is cut on saw, using a modification of stepped block

Tapering with pattern: The rolled spade foot requires the use of a pattern, which should be cut to the outline of the leg, Fig. 14. The machine setup for this is conventional outline planing, the pattern riding a collar of the same diameter as the cutter, as shown in the end view and Fig. 16. If the cut is heavy, waste wood should be bandsawed by turning the pattern over with the work in place, Fig. 17. In fitting the work to the pattern with stop blocks, it should be noted that the thick portion of the leg at the spade foot must be exactly in line with the pattern. In other words, no stock is removed at this point. It can be seen that this is the contact point for final cuts and if wood is removed at this point on the first cut, the work will set deeper in the jig when the opposite side is cut. Note in Fig. 15, that when the spade is narrower than maximum, precutting of the leg to a straight taper simplifies the setup.

TABLE-SHELF

Bracket Table Saves Space in Narrow Hallway

Table legs in a narrow hallway are very much in the way during the weekly housecleaning. Moreover, they make a small hallway appear even smaller and more congested. But mount the table top on a scrollsawed wall bracket and you gain in both space and decorative values. In the crosshatched detail at the left, ¾-in. plywood is suggested for both pieces but instead you can use ¾-in. solid stock for the top and ⅜ or ½-in. plywood for the bracket piece. This makes the scrollsawing job a little easier, especially if you do it by hand. The scroll pattern is rather intricate in detail so sketch in the curved lines full-size on heavy paper. Then transfer the pattern to the wood. Bore all the holes necessary for insertion of the saw blade. Saw slowly. If you hurry the job you'll get rough, irregular edges here and there. Sand both pieces smooth, round the edges or shape them if you have power equipment, then finish with stain, shellac and wax or with clear lacquer. In assembly, the pieces are screwed to a short length of angle iron as shown. This takes the place of shelf supports so commonly used.

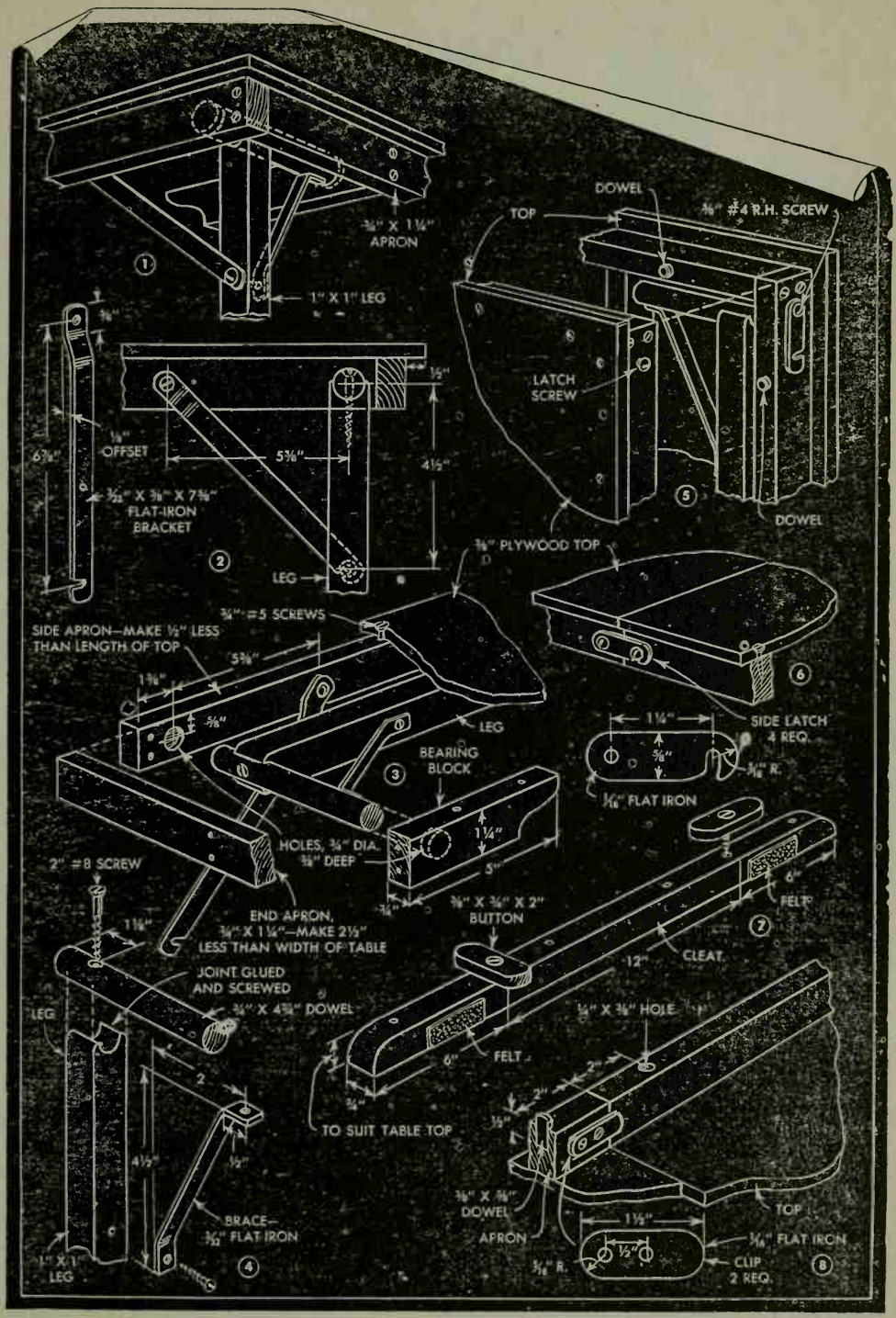
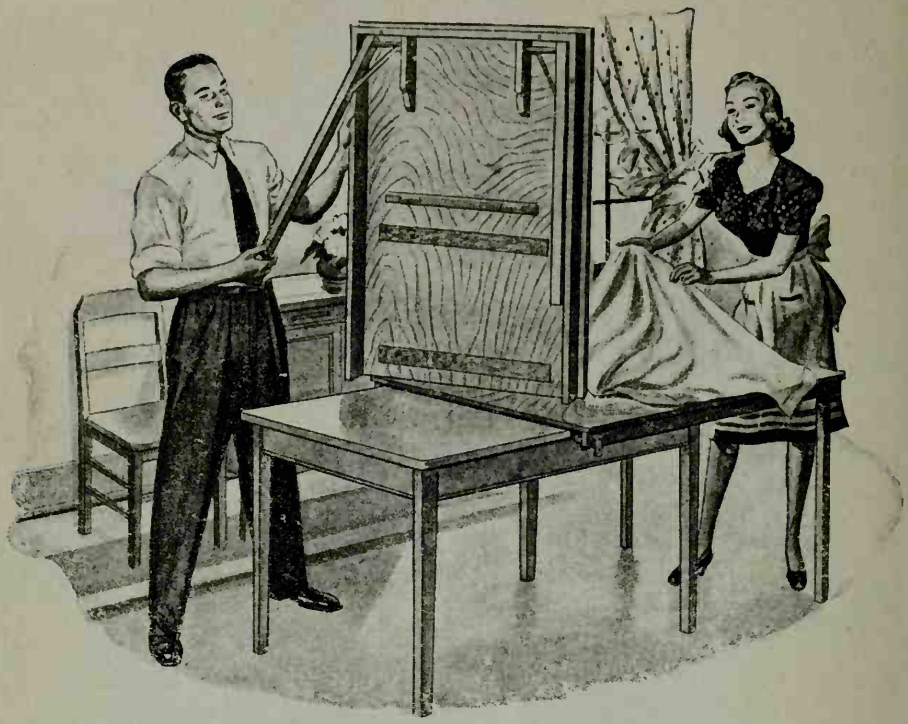

¾" X 1¼" APRON
1" X 1" LEG
1
¾"
6⅞"
⅛" OFFSET
5¾"
½"
4½"
⅜" X ⅜" X 7¾" FLAT-IRON BRACKET
2
LEG
TOP
DOWEL
#4 R.H. SCREW
LATCH SCREW
5
DOWEL
¾" PLYWOOD TOP
¾" = 5 SCREWS
SIDE APRON—MAKE ½" LESS THAN LENGTH OF TOP
5⅜"
1⅜"
⅝"
LEG
3
BEARING BLOCK
6
1¼"
⅝"
⅜" R.
SIDE LATCH 4 REQ.
1/16" FLAT IRON
HOLES, ⅜" DIA. ⅜" DEEP
1¼"
5"
¾"
¾" X ¾" X 2" BUTTON
2" #8 SCREW
1½"
END APRON, ¾" X 1¼"—MAKE 2⅛" LESS THAN WIDTH OF TABLE
JOINT GLUED AND SCREWED
¾" X 4¾" DOWEL
LEG
2
4½"
½"
BRACE—⅜" FLAT IRON
1" X 1" LEG
4
6"
FELT
12"
CLEAT
7
TO SUIT TABLE TOP
⅛" X ⅜" HOLE
2"
2"
½"
⅜" X ⅜" DOWEL
APRON
TOP
1½"
½"
¾" R.
⅛" FLAT IRON
CLIP 2 REQ.
8

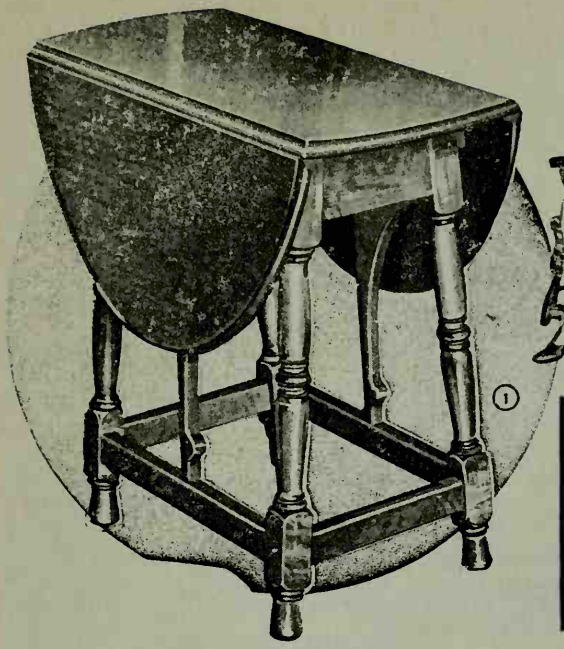
TABLE TOPS

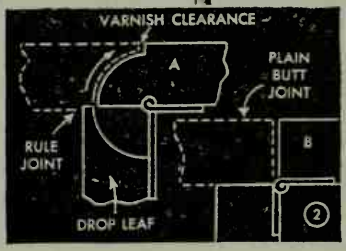
Auxiliary top, ideal as a game table or for holiday dinners, rides piggyback to double table surface



SERVING ten or twelve guests at a dinette table is no problem when you have this "party top." It's like a large card table cut in half and set over a small table to enlarge its top. The two sections hook together at the center and clamp with turn buttons to the edge of the table top. Felt strips line the underside so the top will not mar the finish, and the whole affair folds compactly for storing away in a closet.

Overall dimensions are determined more or less by the table at hand, although a 4 by 10 or 12-ft. panel of plywood will make a top of ample size that's easy to handle. Figs. 1 and 3 show how aprons, to which the plywood is attached, are assembled at the corners and also how each leg is pivoted. After the leg is screwed to a length of dowel and fitted with a brace as in Fig. 4, one end of the dowel is set in a blind hole in the apron and the other end is set in a blind hole in a bearing block. Then a latch is installed as in Fig. 2 to lock the leg rigidly when open. The upper end of the latch is screwed to the inside of the side apron and the lower end is hooked over a roundhead screw driven into the leg. The exact location of the leg screw is important as the latch folds inward toward the center of the table when not in use, which means that the screw must be located at a point where it will not interfere. The length of the legs, of course, is governed by the height of the table on which the top is to be used. The cleats detailed in Fig. 7 should be the same thickness as the dinette table top so that the turn buttons will clamp under the overhanging edge, and they should be located to bear against the table edge. To align the two sections when placing them on the table, metal clips are screwed to the inside of the aprons of one section as in Fig. 8. When it comes to storing the top, the dowel studs shown in Fig. 5 register the two sections in alignment when placed together, after which they are held with latches. Four latches are provided, two at the center joint as previously mentioned, and two at the ends as shown in Figs. 5 and 6. The top may be finished or covered with felt.

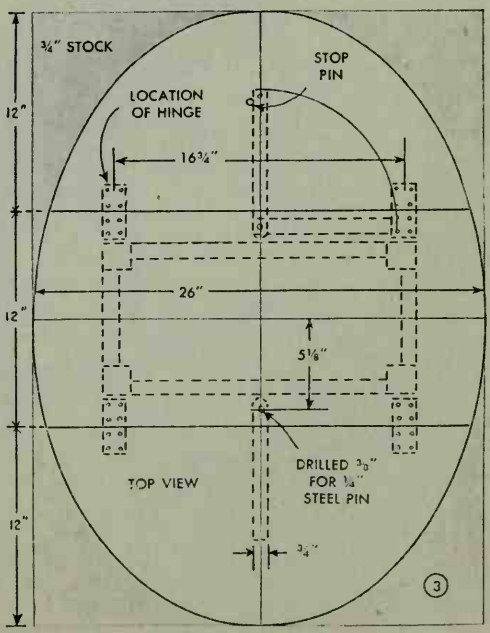




TABLES

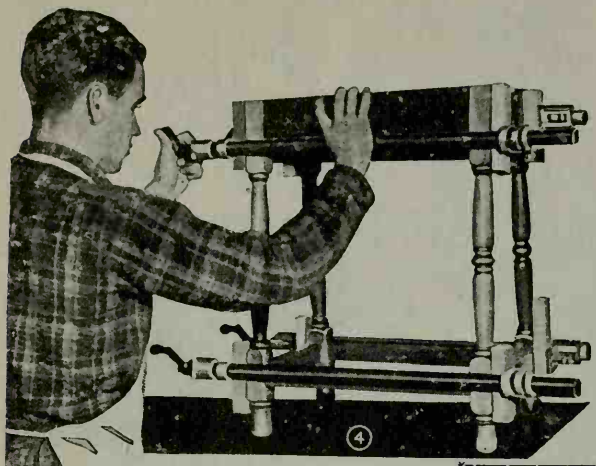
PLACED at a chair or davenport, this table gives variable top space as it can be used with both leaves dropped down as shown in Fig. 1, or with only one leaf extended. And, when both leaves are extended, you have a serviceable coffee table. In keeping with the colonial design, maple is the best wood to use in making it, but it also looks well in other woods.

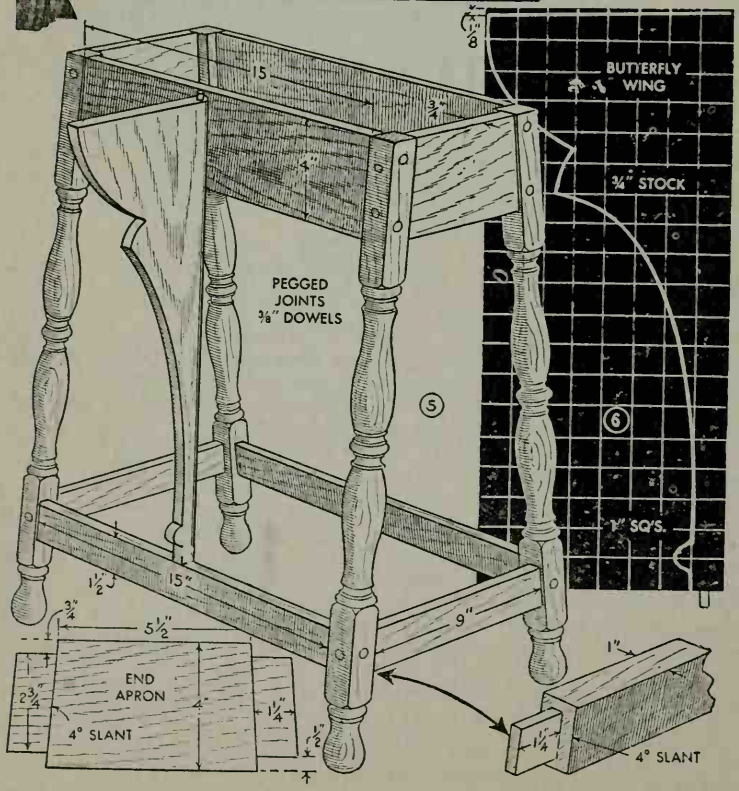
As with most tables, the legs are made first. These are cut from 1⅝-in. stock, squared to 1½ in. and then turned to the dimensions given in Fig. 7. A jig like the one in Figs. 8 and 9 should be used in mortising the legs and cutting tenons on the rails and stretchers. It is made by fastening a block onto a square base 23½ in. long. The block is 4 in. long and one surface is sloped 1$\frac{11}{32}$ in. in 12 in. which corresponds to the angularity of the legs. Another block at the opposite end acts as a stop.

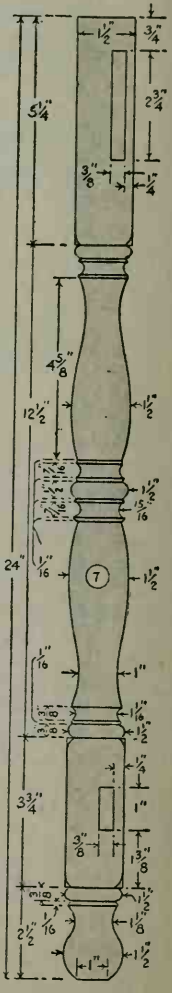


The rails and stretchers are cut to the dimensions given in Fig. 5. It is best to make the angular cuts for the end pieces with the aid of the jig. Rails should be cut first and then clamped with the tenons in the mortises of the legs. The length of the stretchers can then be checked against the length shown in the drawings. When making the cuts with the jig, it will be necessary to lay a narrow piece between the jig and the work, as the blocks are not close enough to support the work. After all tenons have been cut, the table can be clamped together, Fig. 4, the legs marked and the top ends cut off flush with the top of the rails. These parts can then be glued and clamped permanently.

The table top is next, and consists of a center piece and two drop leaves. It is important that all the pieces be planed to the same thickness, otherwise difficulty



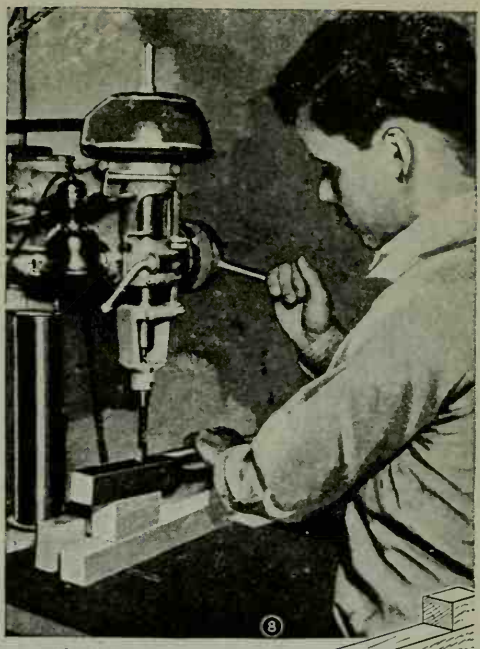




will be experienced in shaping the edges and in hinging the leaves to the center piece. You can use a plain butt joint between the leaves and center piece, or you can use a rule joint, Fig. 2, which is better looking but more difficult to make. The rule joint can be made best on a shaper as in Fig. 11, but don't forget to allow clearance for the thickness of varnish coats at the close-fitting upper edges.

After the joints have been completed, the hinges should be screwed in place and the top cut out to an oval as indicated in Fig. 3. The oval can be laid out with the aid of a marking stick as in Fig. 10. To make it, drill a hole ½ in. from one end to take a lead pencil. Drive two brads into the stick, one 13 in., the other 18 in. from the pencil.

Lay out the axis on the underside of the table top by drawing two centerlines to intersect in the center of the table and form four right angles. Place a large carpenter's square on the lines so that the outside edges are directly over the lines with the corner at the junction of the lines, and clamp it in this position. Then put the marking stick over the square so the brad, 13 in. from the pencil, is against the edge of the square on the long axis and the other brad is against the edge on the short axis. By keeping the brads against the edges of the square as the pencil end of the stick is swung around, one quarter of the oval can be drawn. This same operation repeated four times, with the square moved to the other positions, will result in a perfect oval.



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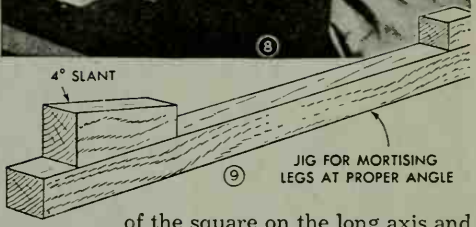

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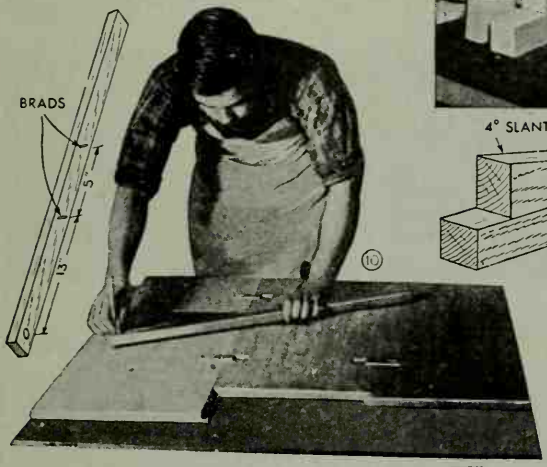

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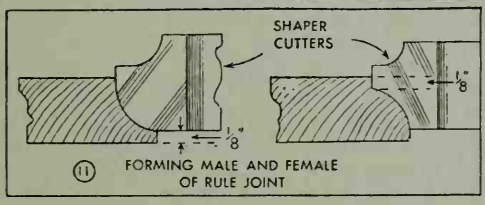
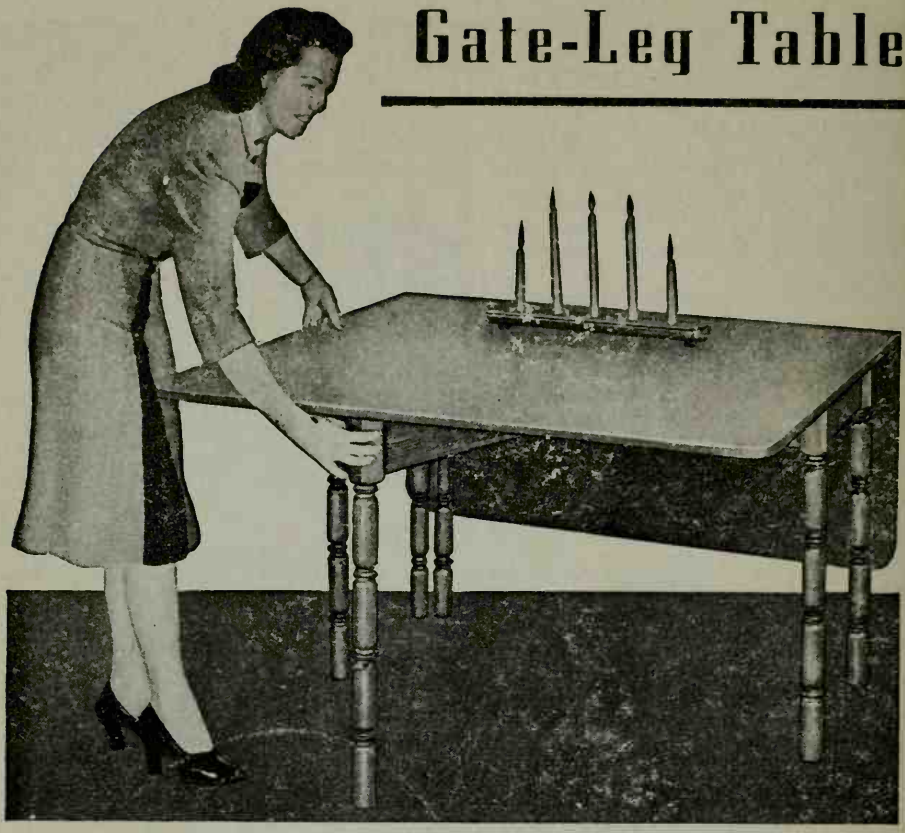


⑪ FORMING MALE AND FEMALE OF RULE JOINT

The wings or leaf supports are the last parts to be cut out as in Fig. 6. The wings are pivoted to the stretchers and top center piece with steel pins. The proper angle at the top edges of the supports can be determined with a sliding T-bevel and the wings cut to this angle. The table can be finished as desired. If a wax finish is used, it is advisable to raise the grain two or three times by wetting before the stain is applied, sanding after wetting the wood each time to remove the raised wood fibers. Wax, of course, must be applied in two or three applications and rubbed in thoroughly between coats.

Gate-Leg Table

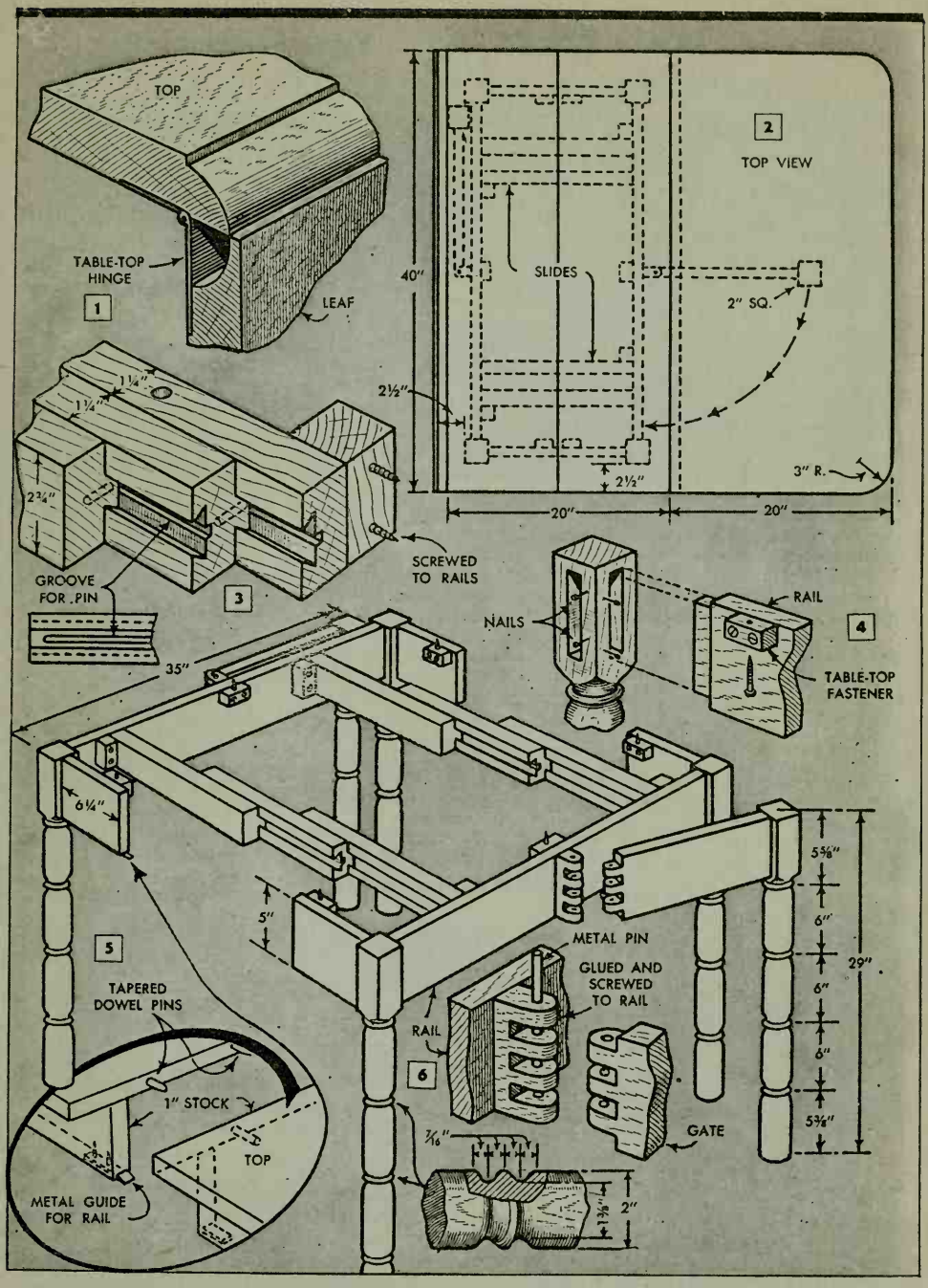


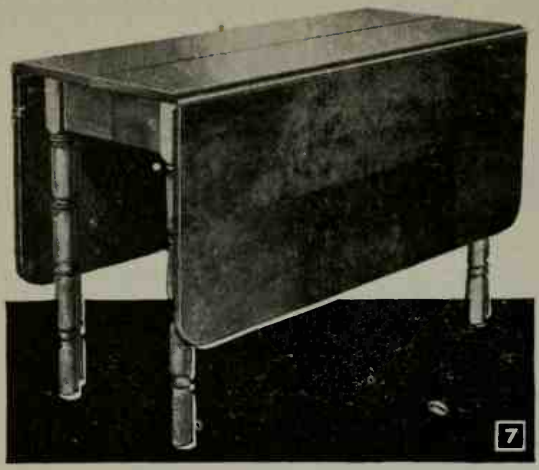
Popular item for the combination living-dining room and small apartment. Takes little space when folded, yet opens to big-table size, seating twelve

HERE'S a dining table that really makes use of limited space. Folded and tucked away against a wall, Fig. 7, it requires only 20 in. of space, but when brought out into the open and fitted with two extra leaves its large top (40 x 84 in.) will accommodate a family gathering of 12 or more. It's a practical answer to the problem of space in the small home or apartment.

The original table was made of American black walnut, the top being walnut burl veneered to a core of poplar. This was done to cut cost, but the whole table, with the exception of the extension-slide assembly, can be made of solid stock. Turn the legs first. These are made from 2-in. turning squares, dressed on four sides. Note that each leg is left square for a distance at the top and the rest is turned to the largest diameter possible. This calls for accurate centering of the turning square in the lathe to assure that all legs have very nearly the same diameter. After the leg is in the round, so to speak, spot the beads with dividers and finish with a roundnose chisel. Although 1-in. stock was used for the rails, ¾-in. material will do. The rails are mortised into the legs as in Fig. 4, the tenons being glued and crosspinned to lock them in place. If you do not have a mortising attachment for the drill press, the leg mortises can be cut by drilling a series of overlapping holes and then cleaning and squaring up the mortise by hand with a chisel. Locate the mortises so that the rails set in about 3/16 in. from the face of the legs. Draw up each assembly with a bar clamp before nailing through the tenons.

The extension slides for the top are made from 1¼-in. hardwood as in Fig. 3. The members slide on a dovetail. Note that the female part of the dovetail has a ⅛-in. groove cut in the bottom. This groove, which is stopped about 1 in. from the end of the slide, is for a stop pin which prevents


TOP
TABLE-TOP HINGE
LEAF
1
2
TOP VIEW
40"
SLIDES
2" SQ.
2½"
2½"
3" R.
20"
20"
1¼"
1¼"
2¾"
GROOVE FOR PIN
3
SCREWED TO RAILS
NAILS
RAIL
4
TABLE-TOP FASTENER
35"
6¼"
5"
5
TAPERED DOWEL PINS
1" STOCK
TOP
METAL GUIDE FOR RAIL
METAL PIN
GLUED AND SCREWED TO RAIL
RAIL
6
GATE
7/16"
2"
1¾"
5⅝"
6"
6"
6"
5⅜"
29"

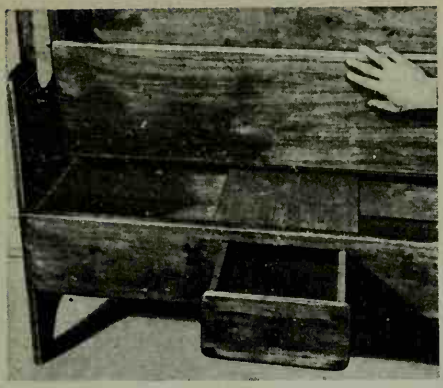


the extension from being pulled completely out. Both slide assemblies are fastened to the side rails of the table with screw blocks, as shown in Figs. 3 and 5. Finally, the outer members of each assembly are counterbored on the underside for short screws, which are used later to attach the two center panels of the top. Screw blocks also are used to fasten the top.

Fig. 2 shows how the gate legs nest against the side rails of the table. The wooden hinge detailed in Fig. 6 was used on the original table, although a regular butt hinge can be used if desired. If a butt hinge is used, glue a stop block to the underside of the leaf so that the gate leg can swing only at a right angle. Stock for the drop leaves must be edge-glued to build up the required width. The leaves are fitted to the top section by what is known as a rule joint, Fig. 1, and are hinged with special table-top hinges. Note that the hinges are mortised flush with the surface and that the pin of both hinges must be located directly below the shoulder cut of the rule joint. This is important as otherwise both surfaces will not be level when the leaves are raised or the joint will bind. To allow clearance for a varnish finish, the concave cut in each leaf must be of slightly greater radius than that of the convex cut. Ladder-back or other colonial style chairs will go well with this table, or matching chairs can be built. The legs should have the same spool design and seats woven with fiber or rush.

Early American Hutch Table

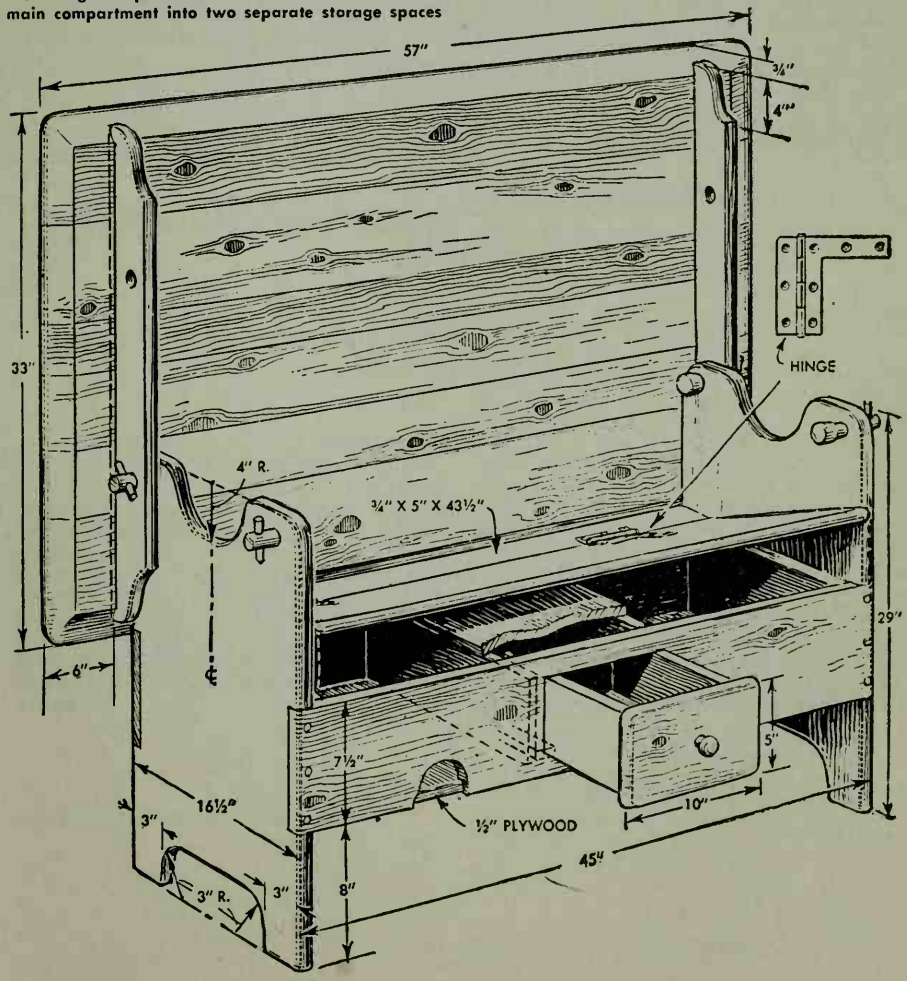
ORIGINAL TABLES of this type were designed and built by early craftsmen with only a few hand tools. Because of space limitations in colonial homes many of the furnishings were designed to serve a dual purpose. The hutch table is a good example. With the pivoted top folded down as in the photo above, it can serve as a writing table or dining table seating four to six persons. Fold the top back as in the photo at the right, and you have an attractive fireside bench, or settle, as it was sometimes called. Tables of this type often were fitted with a storage compartment having a hinged top as in the detail on the following page. This compartment



One of the unusual features of the hutch-table construction is the fully housed drawer at the center of the storage compartment. This construction divides the main compartment into two separate storage spaces

gives the hutch table its descriptive name.

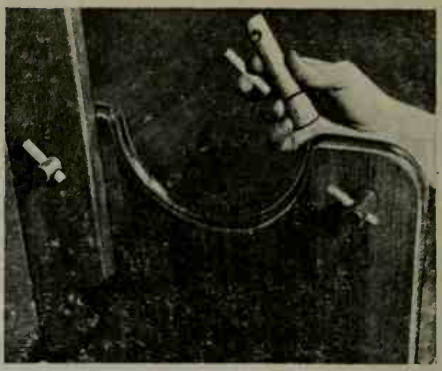
Although the table can be built of walnut, birch or maple, knotty white pine is the traditional wood. This must be genuine white pine of a soft, clear texture and containing only tight, red knots. In selecting the stock, discard all pieces having large, encased knots which may loosen and drop out when the stock is worked. Before cutting material, lay the pieces side by side and arrange them to give the most attractive knot pattern, especially for the top and endpieces. Use 1⅛-in. pine for the top. All other parts can be ¾-in. stock. Cut the individual pieces slightly longer than specified and glue and dowel together to form the required width. Use at least four ⅜-in. dowels in each joint. Then trim to length and sand both sides smooth. Bevel the edges and round the corners as indicated. As-



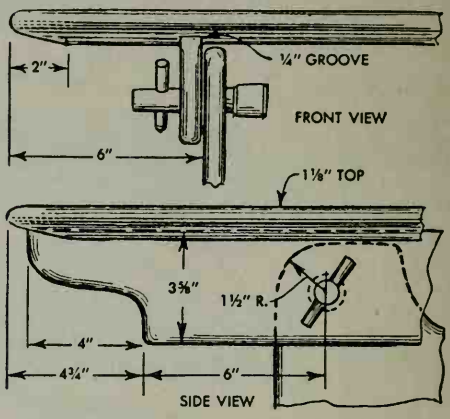
semble the endpieces in the same manner, trimming the ends to give the finish dimension. Make the scroll cuts in both ends of each endpiece, then sand thoroughly to remove saw marks and round the corners in the scroll cuts slightly.

Cleats located near the ends of the top serve both as stiffeners and pivot strips. They are of ¾-in. stock with scroll-cut ends and are placed edgewise in ¼ x ¾-in. grooves cut in the top. The cleats should be joined to the top with dowels and glue. If desired, screws driven into counterbored holes can be substituted for dowels. After driving the screws, the holes are plugged with short dowels or covered with hardwood screw-hole buttons. Four ⅝-in. holes are located and drilled near the top corners of the endpieces as in the details below and on the opposite page. Now invert the top and use the drilled endpieces as templates to drill registering ⅝-in. holes in the cleats for the four shouldered pins. Two of these pins serve as pivots and the other two as locking pins. The pins are turned down from 1-in. dowels, the diameter of the shouldered portion on the two pins which serve as pivots being a full ⅝ in. The other two are shouldered slightly less than ⅝ in. so that they will be a loose fit in the holes. All pins are fitted with retaining keys made from ¼-in. dowels.

The endpieces are joined to stretchers which are open-mortised into the edges at the front and back. The joints are glued and screw-fastened and the screw holes are plugged with dowels. One stretcher is cut out for the center drawer and the ½-in. plywood bottom is nailed into rabbets cut in the stretchers. Endpieces are fitted in the compartment as shown in the detail on the opposite page, and the ends of the plywood bottom are nailed to these for added support. The drawer is boxed into a separate compartment as detailed. This construction divides the main compartment into two separate storage spaces. The compartment top, or lid, is hinged to a 5-in. strip which is nailed, or screwed and glued, to the back stretcher and the endpieces. This method provides sufficient clearance so that the lid will remain in position without a brace or other support when fully opened. If desired, hammered hinges of the H-type



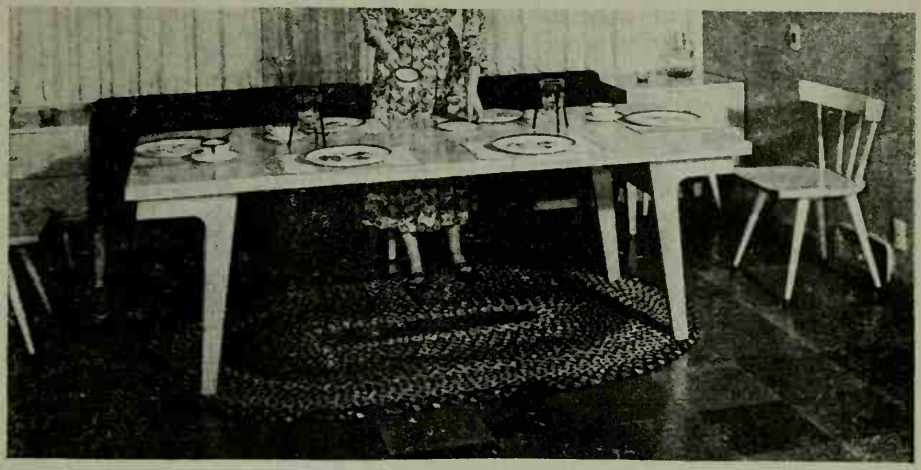
Shouldered hardwood pins fitted with retaining keys prevent tilting of the table top when in the horizontal position. The back pins serve as pivots when the top is raised to vertical position to form seat back



can be substituted for the type shown.

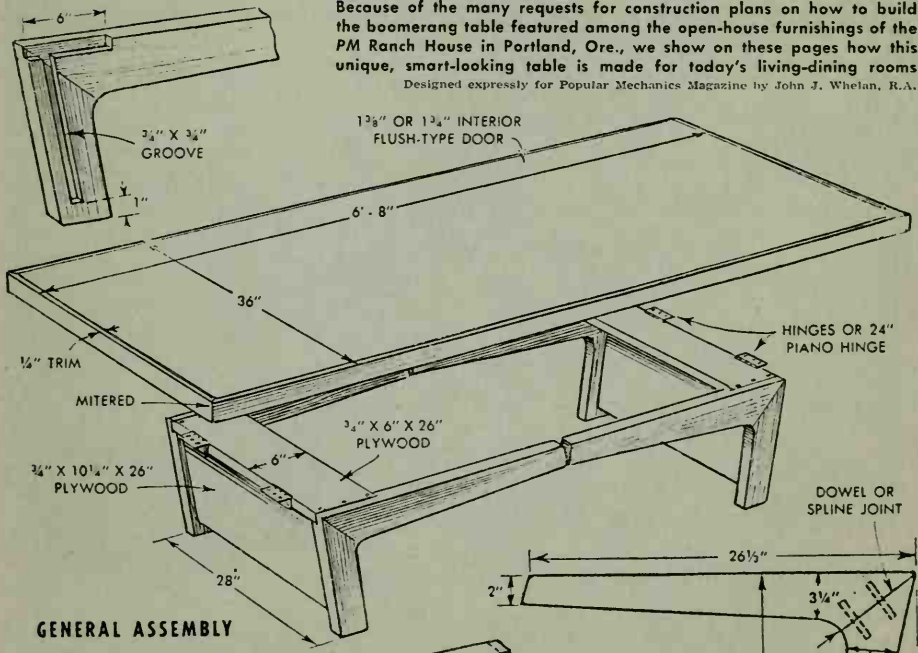
Prepare the surfaces for finishing by sanding all exposed edges smooth and slightly rounded. An attractive finish that closely matches the original can be produced by reducing Van Dyke brown oil color in a half-and-half solution of linseed oil and turpentine and applying this improvised stain with a soft cloth, rubbing until the desired color is obtained on the bare wood. Allow to dry thoroughly and then apply a sealer, two coats of white shellac and wax. ★ ★ ★

BOOMERANG TABLE



Because of the many requests for construction plans on how to build the boomerang table featured among the open-house furnishings of the *PM* Ranch House in Portland, Ore., we show on these pages how this unique, smart-looking table is made for today's living-dining rooms

Designed expressly for Popular Mechanics Magazine by John J. Whelan, R.A.

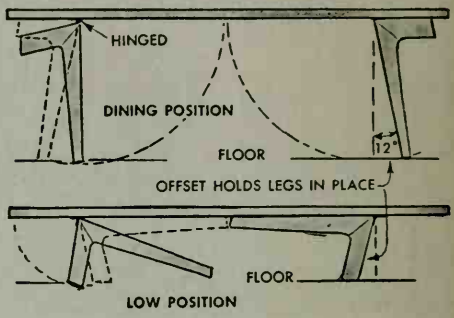


DUBBED "BOOMERANG" because of the characteristically shaped legs, this unique piece of functional furniture is the practical answer to the space problem in today's combination living-dining room. It serves as a swank cocktail table and a spacious dining table all in one. The particular shape of the hinged legs provides extreme rigidity when the table is raised to the dining position, and due to their being offset 12 deg., no hardware is required to lock the legs in place.

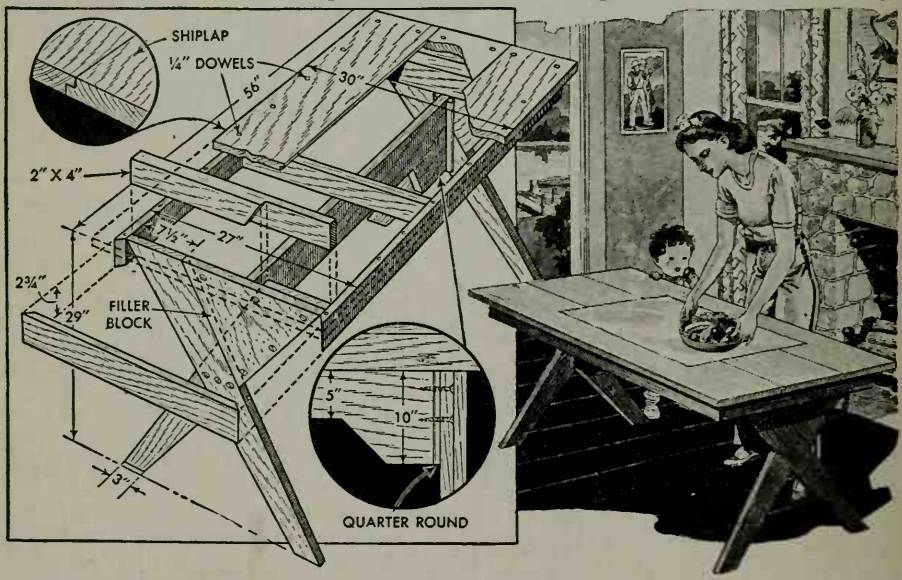
Its utter simplicity of construction stems from the fact that the ready-made top is a flush-type door. A 1⅜ or 1¾-in. interior, or hollow-core, door is recommended and all that the top requires is a ¼-in. facing strip glued to the edges. The drawing on the opposite page shows how this is mitered at the corners, and also shows how the twin leg units are put together, each individual leg being cut as indicated from a 36-in. length of 1¾-in. stock. Plywood "stretchers," ¾ in. thick, fit into stopped rabbets cut in the inner corners of the legs to tie the latter together. Hinging the leg assemblies to the underside of the door completes the table. Center these under the top and allow about ⅛-in. clearance between the legs when the table is in the low position. Furniture glides on ends of legs are optional.

A simple way to obtain a bleached finish with either birch or oak is to give the table a coat of white resin sealer, then sand to the tone desired and follow with two coats of clear resin sealer, varnish or wax.

These two drawings show how the boomerang-shaped legs swing to convert the table from a low cocktail table to a roomy dining table in a matter of seconds



Reinforced X-Legs Make Cottage Table Sturdy



Built of pine or other common lumber, this sturdy table is doubly reinforced for use in cabins or summer cottages. Construction is simplified by using X-type, tapered legs, which are made flush across the table ends by a triangular filler block. A cross brace, cut as shown in the lower detail, assures rigidity. Seasoned lumber should be used for the top, which is doweled in place. If unseasoned lumber is used, the boards may shrink and leave openings. Therefore, they should be nailed on temporarily until completely shrunk, after which dowels are substituted for the nails. After the table has been well sandpapered, the application of two coats of shellac and one or two of liquid wax will prevent stains from soaking into the grain.

Fig. 1—Here's an easy way to weatherproof your windows for winter if you don't have storm sash. Apply strips of cellulose tape to inside of all cracks around the sash and sills, making sure it doesn't wrinkle

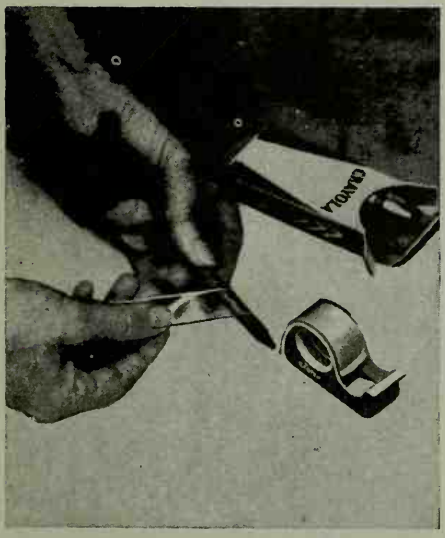


Fig. 2—Cellulose tape is wrapped spirally around the crayon and is peeled off as necessary to expose more of the tip. Tape reinforces the crayon when the youngsters really bear down to get the color on thickly

Tape Tips

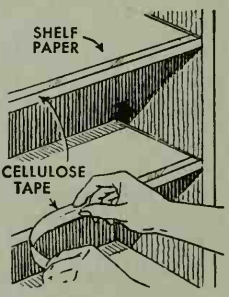
CELLULOSE TAPE, that is. This transparent tape has found its place in the home. It's as commonplace on the shelf as aspirin, but it has a lot more uses. For instance, if you bought the last roll of cellulose tape at the hardware store chances are that the hardwareman didn't tell you that you could do a pretty good job of weatherstripping the windows. A few cents' worth of cellulose tape goes a long way to provide an inexpensive and satisfactory insulation that will keep out wintry blasts.

To do this, simply follow the instructions pictured in the upper left-hand illustration. Reel out enough tape to cover the inside of all cracks around the sash and sills. The cellulose tape is tough enough to withstand drafts coming through the openings, and will be effective in raising the temperature of the room you are having trouble heating.

At the same time you can strip a piece of cellulose tape over any crack in the window pane. The tape will do the trick till you can get it fixed.

Even if the windows are already weatherproofed you may find one to be a rattling nuisance. Don't wedge it. Tape it. An inch or so of cellulose tape placed at the shaky points and the job is done.

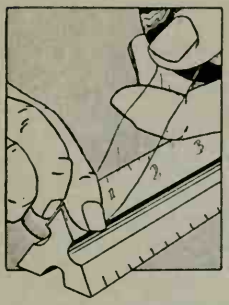
Breakproof crayon: Crayon tends to crumble or break when pressure is applied. To prevent this from happening, unroll some cellulose tape and wrap a strip spirally around the crayon, as illustrated on the lower left. The added protection allows the ambitious youngster to bear down on the crayon. And it also helps to keep the young artist from getting smeared up. As the crayon wears down, unwind the spiral wrapping to expose more of the tip.



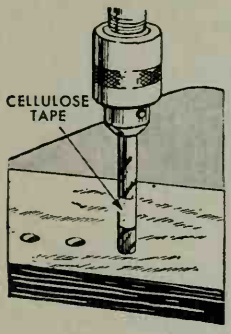
Taping down shelf paper: Thumbtacking shelf-lining paper to a cupboard shelf or pantry shelves often results in the paper shifting and tearing at the points where it is held by the tacks. This will not occur if cellulose tape is used instead of thumbtacks. Apply half the width of the tape to

the front edge of the paper and stick the other half to the edge of the shelf as shown. When shelving paper is used which has the decorative edging, small tabs of tape can be applied at each end and across the back to hold it.

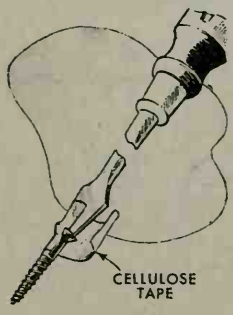
Keeping rulers legible: Artists and others who use a wooden scale can keep the calibration marks and figures clean and legible by covering the scale when it is new. Cellulose tape is used and will last indefinitely if it is pressed firmly in contact with the scale. When it is necessary to renew the tape, be sure that all adhesive has been removed from the ruler before applying the new tape.



Depth gauge for hand drill: When using a hand drill to bore a number of holes to the same depth or a single blind hole to a predetermined depth, cellulose tape comes in handy as a depth guide. Take a small tab of the tape and wrap it around the bit so that the lower edge of the tape is the desired distance from the tip of the bit. Without removing the drill several times for inspection, you can now drill safely until the edge of the tape is flush with the surface of the work, thus eliminating guess work.



Starting screws: In places where screws cannot be held in starting position with the fingers, they can be started easily if they are taped to the tip of the screwdriver. With the tip in the screw slot, a small piece of cellulose tape is wrapped around both the head of the screw and the end of the screwdriver. The greater width of the tape should be stuck to the screwdriver blade so that when the latter is pulled from the screw the tape will be removed with it.



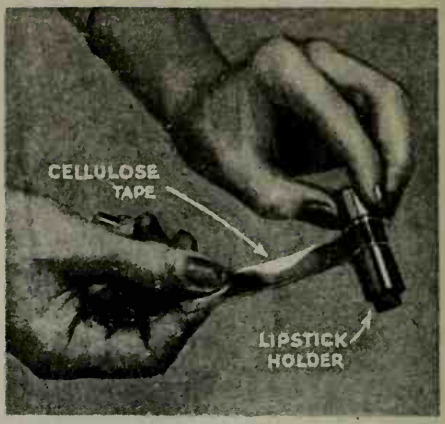


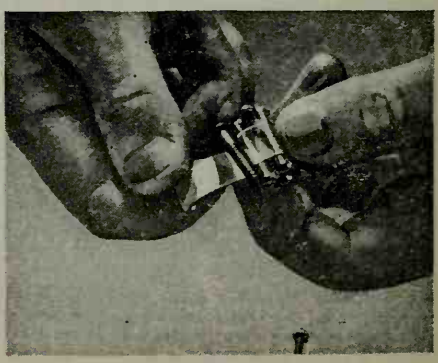
Fig 3—Loose cap on lipstick holder or similar container can be tightened by relining holder with strip of tape

Making loose caps stick: An annoyance is the constant falling off of lipstick-holder caps or covers of similar containers. This bothersome misfitting can be easily fixed by wrapping a strip of cellulose tape around the holder at the edge, as shown in the above illustration. The tape is hardly noticeable and will pad the holder enough to keep the cap secure.

Identifying and locating screws: It's easy to find a screw of the right size if you keep them in rolls of cellulose tape, as illustrated below. Take the box of miscellaneous screws that you have on hand and sort them into lots of the same size. Lay each lot in a row on a strip of tape with the tacky side up and roll them up. When you want any particular kind of screw, just peel it off the roll.

Snagging curtains: Threading plain or lace curtains is a trying task. If you are

Fig. 4—It's easy to find a screw of the right size if you keep them separated in rolls of transparent tape



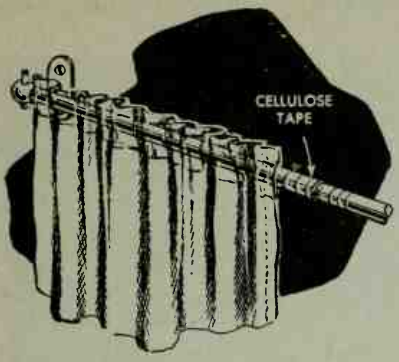


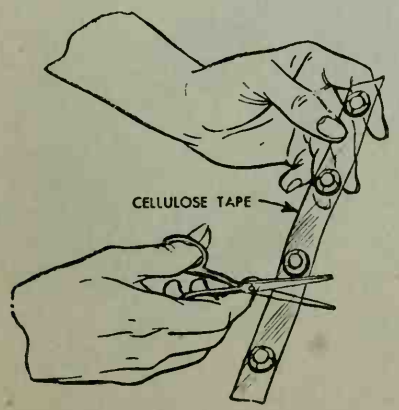
Fig. 5—When the joints of extension rods are covered with cellulose tape, curtains slide on without snagging

having difficulty in threading curtains on a flat or round extension rod the material is apt to be torn by its snagging at the joints of the rod. To prevent this, wrap a protective covering of cellulose tape over the joints and the curtains will slide over them. If the tape is covered by the curtains, the rod can be taped when fully extended and the tape left in place.

Button separator: Matching buttons cut from an old garment and saved for reuse can be found quickly in the sewing box if they are held together with strips of cellulose tape. The buttons are sandwiched between two strips of tape so they can be seen at a glance. The illustration below shows how the buttons are snipped off the strip as needed.

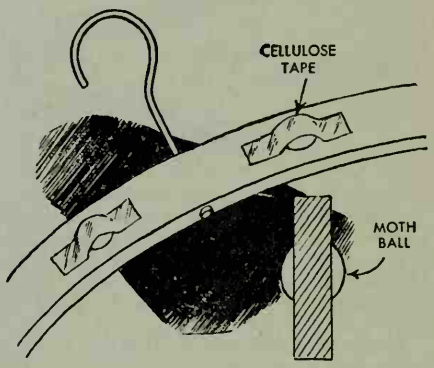
Stopping rust rings: Rust rings caused by setting scouring-powder containers on porcelain fixtures in the kitchen or bathroom can be prevented by covering the bottom edges of the cans with strips of cellulose tape.

Fig. 6—Buttons are sandwiched between two long strips of clear tape and are snipped off when needed

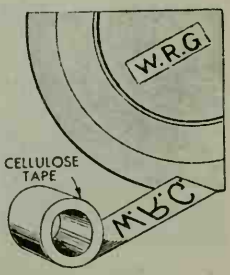


Clamp for gluing jobs: Cellulose tape provides a quick and effective gluing clamp for model work and other jobs where it is necessary to keep tiny parts together. Small parts of almost any shape can be clamped together and the tape removed easily without damage to the work.

Clothes protection: Moth balls can be kept right on the hanger where they will do the most good by a very simple operation. First of all, drill two or three holes in the wooden frame of the coat hanger. Then place a moth ball in each of the holes. Tape the moth balls in position so they will not fall from the holes.



Identify picnic dishes: Print your initials or symbols on the adhesive side of strips of cellulose tape and apply them to the undersides of dishes used on picnics or other group gatherings, and you will be able to identify your own dishes easily. The tape will keep the initials legible for a few washings. It is best to use a ball-point pen for the lettering as you can better apply just the right amount of ink with it and thus avoid smearing when you press the tape against the dish.



Removing decals: Removal of decals on objects is made extremely easy if cellulose tape is applied to the unwanted decal, pressed on firmly and peeled off. The design will usually adhere and come off with the cellulose tape. Apply a warm, but not too hot, iron to the transfer first to loosen it, if removal appears to be difficult. By using this method to remove decals, you can avoid marring the surface of the object.

Renewing envelopes: If you want to reuse a heavy Manila envelope, the stamps and any labels can be easily removed with cellulose tape. Completely cover the portions to be cleaned with the tape and pull the tape loose. If it doesn't come off the first time, try again but be sure that the cellulose tape is pressed on firmly.

Sealing screen holes: Small holes in window screens can be patched temporarily with strips of cellulose tape. Cover both sides of the hole with the tape and then press the adhesive surfaces of the tape together. As the tape is transparent, it will not be too noticeable.

Removing lint: Here's how to make lint and dust particles disappear from clothing as if by magic. This little operation is done in a jiffy with cellulose tape. Wrap a small strip of the tape, sticky side out, around the finger, as illustrated in the drawing, and stroke the fabric lightly.

Lamp-cord insulation: Usually when a lamp cord hangs over the corner of a desk or table the insulation tends to wear or break. To prevent this from happening, wrap a few turns of cellulose tape at these spots on the cord. This stiffens the cord in much the same way that a spring stiffens the hose of a sprayer or other similar appliance requiring reinforcement.

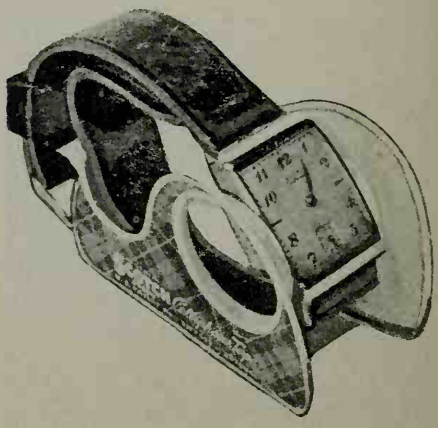
Removing hardened glue: Here's a novel idea to use in the workshop to add to your woodworking pleasure. Scraping excess glue from wood joints is eliminated if the parts to be glued are masked close to the joinings with strips of cellulose tape, as shown in the illustration at the left. It is then easy to strip off the hardened glue by simply pulling away the tape from the woodwork.

Reinforce book pages: To facilitate turning pages of reference books and manuals and also to protect them from wear, fasten cellulose tape to the edges of the pages. Cut the tape into strips of the same length as the pages. Stick half the width of a strip to the edge of one side of the page and fold neatly around the edge and press down the other half.

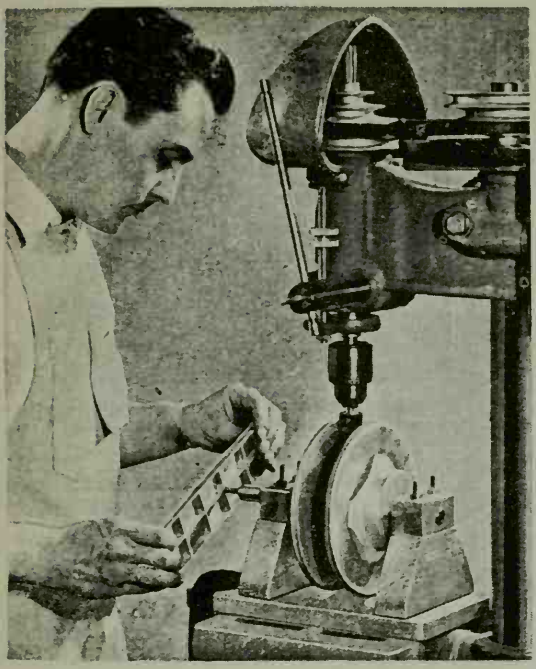
Retipping shoelaces: Should the tip of a shoelace be lost or damaged you can make a satisfactory replacement. Wrap a few turns of cellulose tape around the end of the shoelace, as illustrated above, and you will have a tip that will last as long as the lace itself.

Fountain-pen repair: Sometimes the threads on a fountain pen wear to a point where they no longer hold the cap securely. You can fix this looseness by wrapping a piece of cellulose tape around the threaded portion of the pen barrel. This increases the diameter of the threads just enough to make the cap fit tightly again. The tape is barely noticeable if it is pressed into the thread grooves by turning the cap on and off and several times.

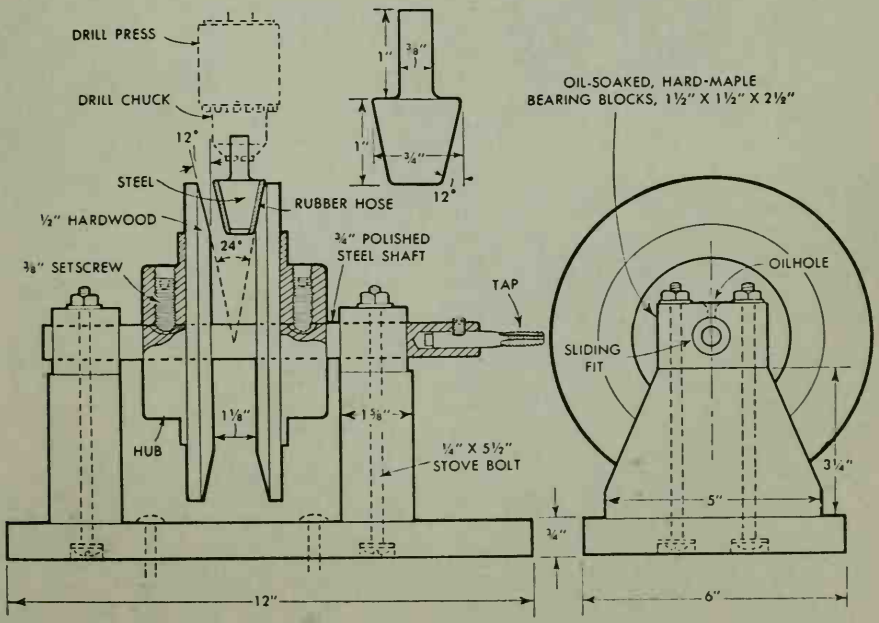
Wristwatch holder: If you have used many of the tips suggested, there is probably an empty tape dispenser on hand. Don't toss it away. As shown below, you put the finishing touch to the list of tips by fashioning a watch holder for the desk or bedside table. Insert the watch between the sides of the dispenser and adjust it to the angle at which the face of the watch is most readily seen.



DRILL-PRESS TAPPING JIG

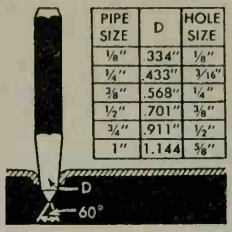


DESIGNED especially for the small production shop, this drill-press jig eliminates the bottleneck frequently caused by hand tapping a number of parts. By using the jig, the tap is automatically driven into the hole when the work is pressed against it, and then the tap is backed out by pulling the work away from it. This is accomplished by a pair of 7¼-in.-dia. hardwood disks mounted on a sliding shaft to reverse the direction of tap rotation when one or the other disk is held in contact with a rubber-covered driving spindle. The latter is tapered to match a bevel on the inside faces of the disks. Bearing blocks of hard maple are fastened to the base blocks with long stove bolts and the base is drilled to permit bolting to the drill-press table. Made to the dimensions given, the jig will handle taps up to ¼ in. If larger or coarse-thread taps are to be used, the diameter of the disks should be increased.



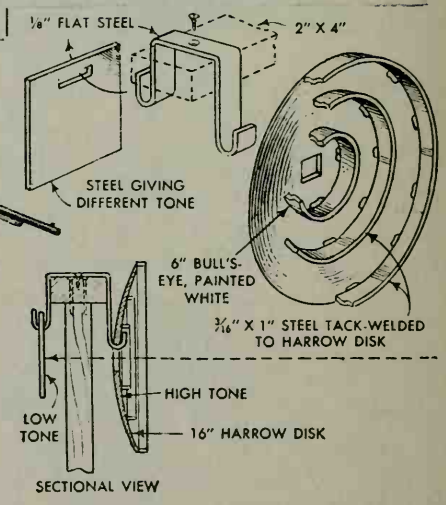
Better Way to Tap Thin Metal

To obtain greater depth of thread when tapping thin sheet metal, drill an undersize hole and enlarge it to the proper diameter with a tapered punch. A small line scribed around the punch will serve as a guide in determining how far to drive the punch for any particular size of hole. For pipe threads, the taper on the punch should be the same as the taper on the thread. The table shows the size hole to drill, and the enlargement to make with the punch, D, for the pipe sizes indicated in the left-hand column.



PIPE SIZE	D	HOLE SIZE
1/8"	.334"	1/8"
1/4"	.433"	3/16"
3/8"	.568"	1/4"
1/2"	.701"	3/8"
3/4"	.911"	1/2"
1"	1.144	5/8"

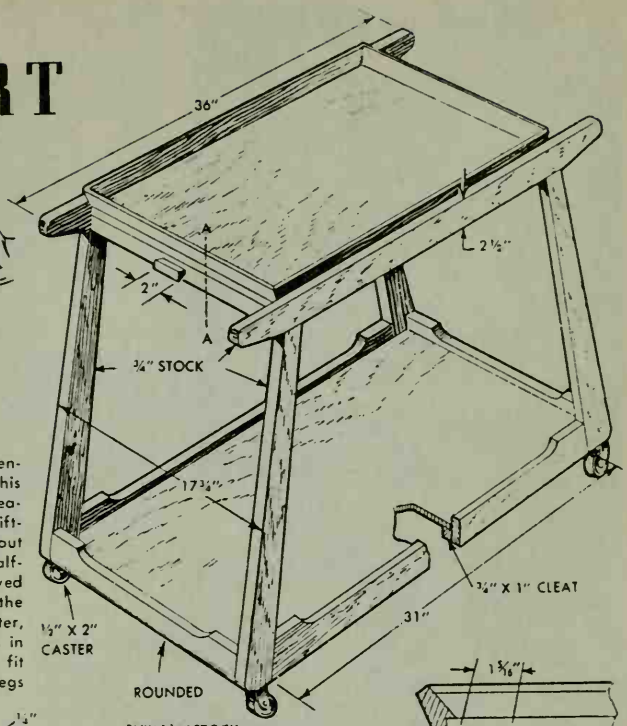
TWO-TONE TARGET

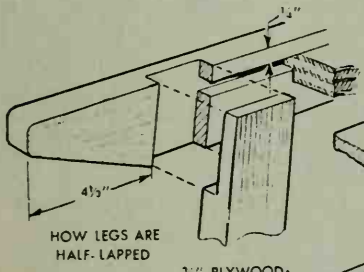


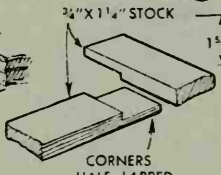
HERE'S A NOVEL plinking target for your .22-cal. rifle, using regular ammunition. When hit, a disk-harrow blade gives out a high-pitched ringing tone, but a bullet that passes through the square center hole in the disk strikes a piece of 1/4-in. flat steel suspended directly behind the disk. The lower tone of the flat piece records the high-scoring shot. Set up the target as shown in the illustration above with a high bank of earth directly back of it to stop stray shots harmlessly. Height of the target can range from 3 to 6 ft. above the ground and the firing point should be at right angles to the curved face of the disk. For open-sighted rifles the range can vary from 25 to 75 yd., with 50 yd. a good average. Accurate shooting can be done with scope-sighted .22s at much longer ranges. Flat steel rings welded to the concave face of the disk prevent ricochets when using ordinary lead bullets. If gallery ammunition with splashproof bullets is used the rings are not necessary. However, gallery-type ammunition is practical only for short ranges. It should be understood, of course, that this target is suitable only for use with .22-cal. rifles chambered for cartridges no larger than .22 long rifle.

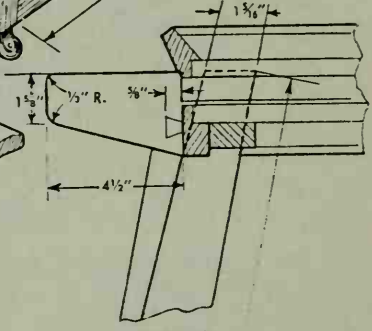
TEACART

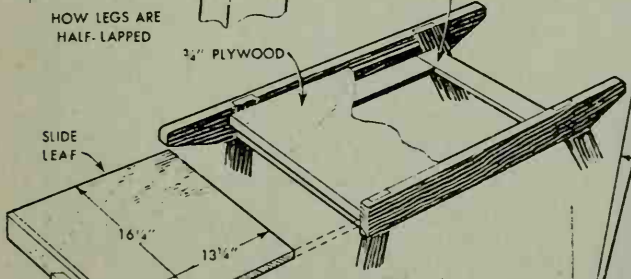
A modern take-off on the conventional large-wheel tea wagon, this modified version retains all the features of its prototype—including lift-off tray, portability and pull-out shelves. The shelves slide on a half-lapped frame which is edge-screwed to the side members ⅝ in. below the plywood top of the cart. The latter, which is rabbeted to fit grooves in the side members, is notched to fit over the slanting, half-lapped legs

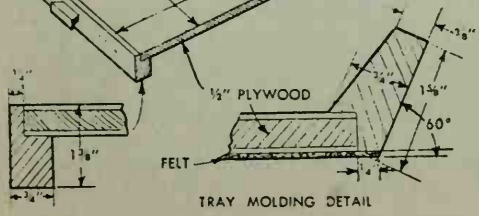




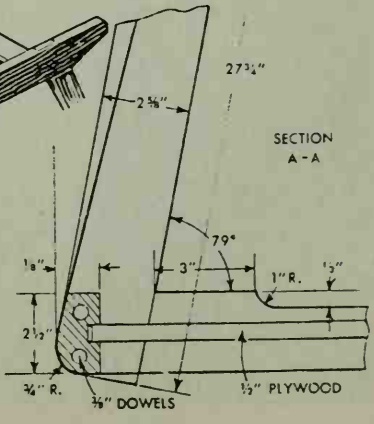


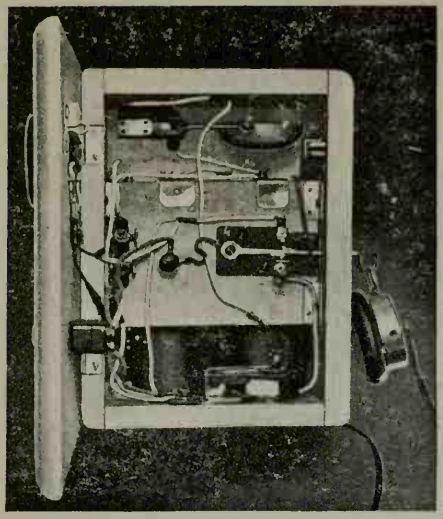






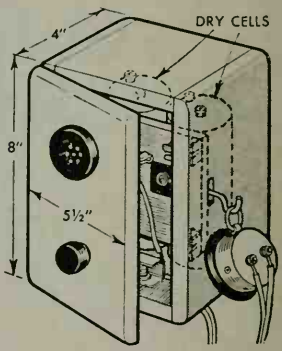
TRAY MOLDING DETAIL

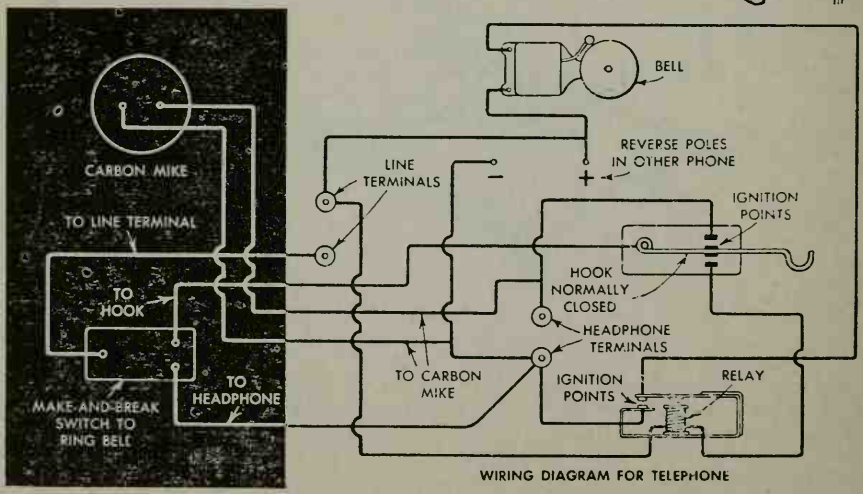




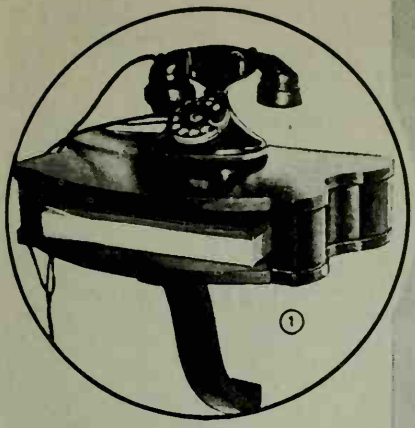
TELEPHONE

YOUNGSTERS will have a lot of fun with these midget phones when they are installed between floors in the home. They also have a practical application in larger suburban homes and on the farm. The individual phones are easily made as in the detail at the right which gives the over-all dimensions of the phone box. The diagram below shows how to wire the units. Radio headphones serve as receivers and carbon hand mikes as transmitters. Two No. 6 dry cells are connected in series in each phone unit. When the phones are more than 100 ft. apart, voltage drop in the line may make it necessary to install a relay to supply sufficient current to ring the bell or buzzer in the distant phone box.



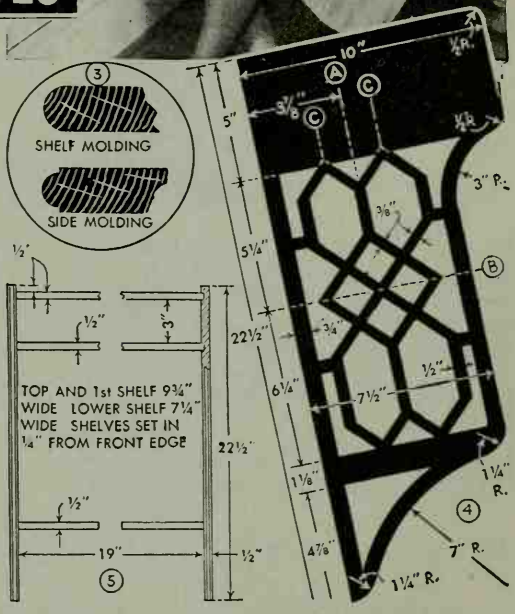


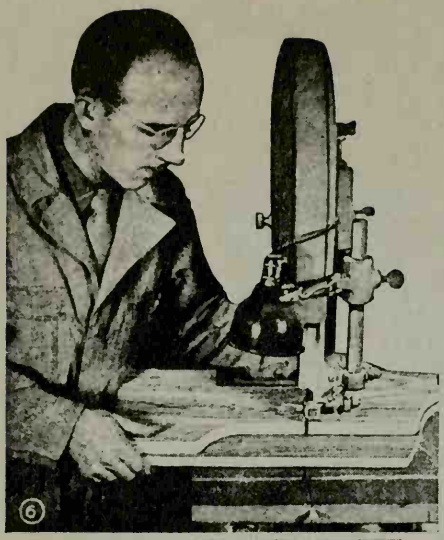
WIRING DIAGRAM FOR TELEPHONE



Two Smart
TELEPHONE SHELVES

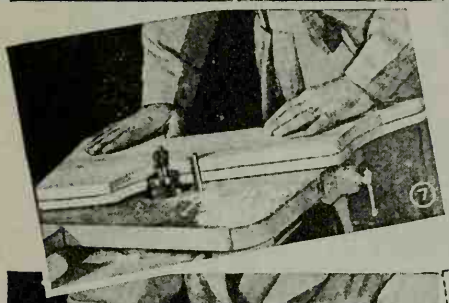
NO FLOOR space is taken by either of these neat little telephone shelves, as they hang right on the wall where they are out of the way when dusting around the baseboard. Both have built-in space for a directory besides a pad and pencil. To make the one shown in Fig. 2, first lay out a cardboard pattern of the fretwork sides according to Fig. 4. Dotted lines A, B and C represent centerlines of the cutout portions, lines C being located with a 45-degree triangle from line A. After the pattern is cut out, a wooden template is cut to match the outside contour of the pattern, which is used as a master pattern in shaping the edges with a molding like the one shown in Fig. 3. As any irregularity in the template will be duplicated in the work, the edge of the template should be smoothed carefully and coated with wax or paraffin to reduce friction against the spinning shaper collar. The ½-in. stock for the sides should be about ⅛ in. wider than the width of the template, and is fastened temporarily to the latter, flush with the rear edge, by a couple of screws driven into the waste parts of the fretwork. After this, the work is bandsawed as in Fig. 6, sawing around the template about ⅛ in. away from the edge. With the work attached to the template, the edges are shaped as in Fig. 7, the template being on top and a starting pin engaged in the table. The shaper collar used should be of a size that will keep the work about the same size as the template. You may find it necessary to allow more than a ⅛-in. margin around the work, depending on the size collar and cutter at hand. The best procedure to follow in running the mold is to start at the rear and go across the end grain at the top



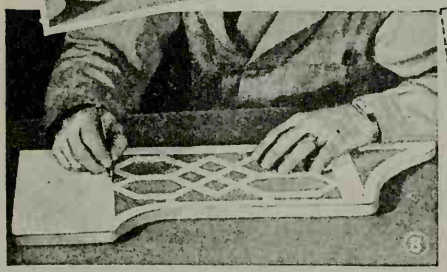


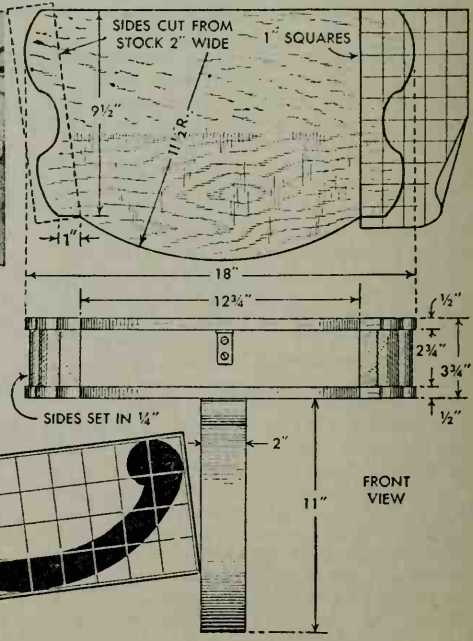
and down the front edge. This will give a clean cut as you will be going with the grain most of the way. Keep the work moving and apply just enough pressure to hold the work in contact with the collar, to prevent burning the wood. Each side piece is shaped in this way. If a number of pieces are to be cut from the same template, it is best to make it of hardwood, so that repeated usage will not wear the working edge too rapidly and thus change the original shape of the template.

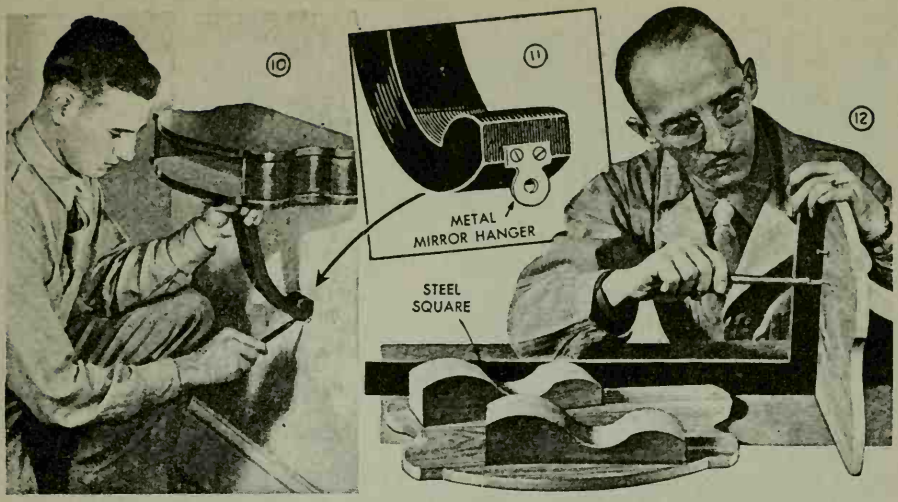
Now with the work removed from the template, the blind grooves for the three shelves are cut with a dado saw or router, spacing them according to Fig. 5. These should be cut about ¼ in. deep and stop ⅜ in. or so from the front edge. Next, the fretwork design is traced on the work as in Fig. 8, after which it is scrollsawed and sanded. If your saw can handle 1-in. stock, time can be saved by tacking both pieces together and sawing at one time. In fitting the shelves to the sides, note that they must be notched at the corners to set ¼ in. in from the front edge. Angle brackets for attaching the shelf to the wall are screwed to the underside of the top before assembling with a resin-type glue. Finally, the work is checked for squareness before drawing the clamps up tightly.



Both top and bottom shelves of the model shown in Fig. 1 and detailed in Fig. 9, are bandsawed from panels of solid stock glued up of several pieces. The pattern used in marking the ends of the shelves also can







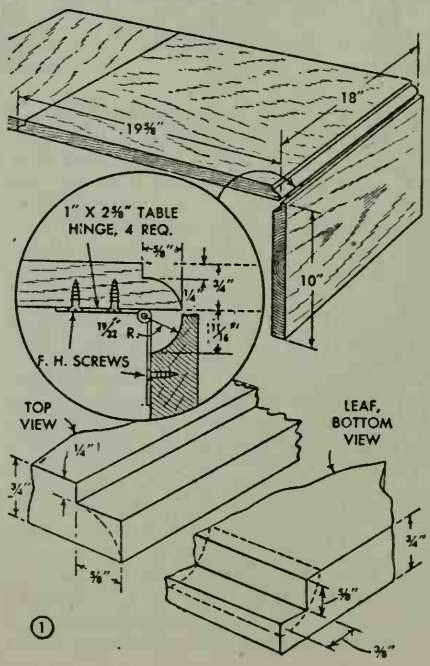
be used to mark the thick end blocks to which they are glued. This merely requires drawing a second line ¼ in. in from the first, which represents the amount the ends are set in. If solid stock is not available, built-up blocks of ¾-in. stock, glued face to face, will do for the end pieces as well as the brace. The bottom shelf can be attached to the end pieces with f.h. screws, as they will not show, but the top will have to be fastened with several blind dowels. A framing square, used as shown in Fig. 12, will assure the brace being at right angles to the wall. An angle bracket is provided to fasten the shelf to the wall at the top, while a mirror hanger is screwed to the end of the brace to hold it at the bottom, Figs. 10, 11.

TELEPHONE STANDS

TWO small drawers in this attractive telephone stand provide ample space for storing directories, memo pads and similar items, which often are stacked on the stand or on the floor nearby. The stand has space for a lamp and a bowl of flowers as well as the telephone, and, used with one or both of the end wings or leaves raised, it will serve as an emergency occasional table in any room in the house.

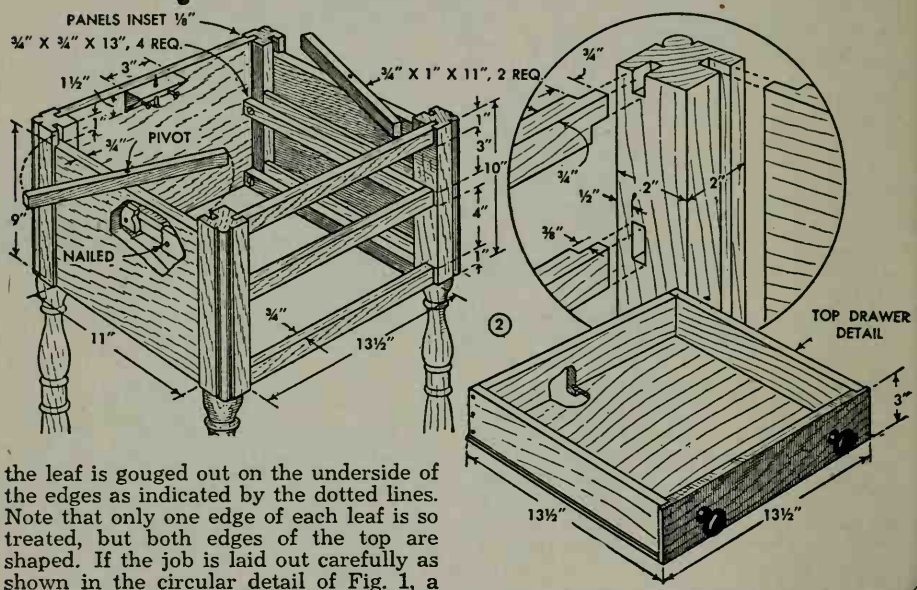
The stand looks most attractive when done in walnut, mahogany or maple. If desired, its construction can be brought entirely within the scope of hand tools by substituting tapered, square legs for the turned ones. All other work, except the knobs, which may be purchased, can be done with hand tools alone, including the shaped edges of the top piece and leaves as indicated in Fig. 1.

In shaping these edges, preliminary saw cuts remove much of the waste stock and provide a straight rabbeted edge for the joint at the same time, as indicated by the two lower details, which show views of the leaf and table top. The material remaining on the edge of the top is rounded off with a sharp chisel or plane, and excess stock on



until it works freely. Careful attention to this detail will result in perfect positioning of the leaves, whether in the raised position, or hanging as in Fig. 1.

Full length mortises and tenons join the back and both side panels to the legs, Fig. 2, the mortises running ⅛ in. from the outside surface of the legs. The mortises can be cut by grooving with a rabbet plane, or on a circular saw. The three parting strips that space the drawers are similarly mortised and tenoned. In all these joints the shoulder of the tenon faces toward the outside of the piece. Cut the mortises and tenons carefully

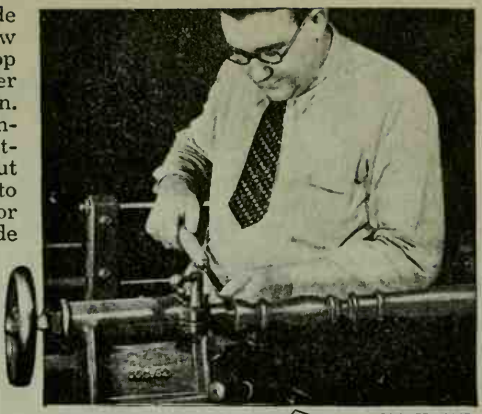


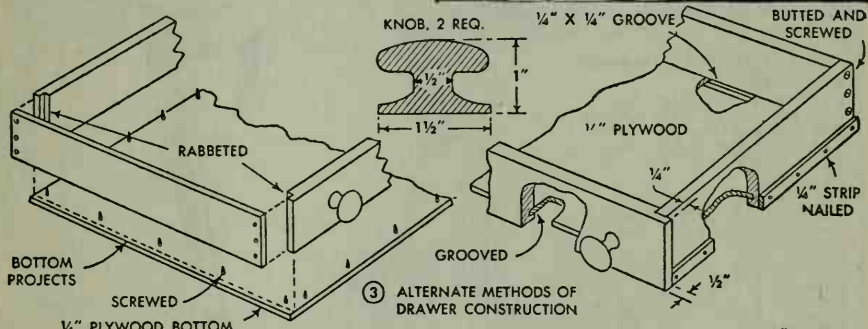
the leaf is gouged out on the underside of the edges as indicated by the dotted lines. Note that only one edge of each leaf is so treated, but both edges of the top are shaped. If the job is laid out carefully as shown in the circular detail of Fig. 1, a neat, free-working joint will result. However, if you have access to a power shaper, much tedious work can be avoided by cutting the joint on it, using a set of cutters designed especially for this kind of construction. The same type of shaper cutters designed for use on a bench saw also are procurable and do the work well. Remember that it is important for the operator to work with the grain of the wood when making these cuts.

Probably the most exacting feature of this project lies in hanging the leaves. This is done with the top piece turned upside down and the leaves in place. Set the four table hinges in position about 4 in. in from both front and back edges, pressing the parts together so that the joint works tightly, and then sand the contacting edges to get snug fits, and then glue them into place. It is best to run the mortises in the legs before shaping them. When this has been done turn the legs to the size and shape indicated in Fig. 4, and assemble as in Fig. 2. The outside edge of the square portion of each leg may be beaded if desired, but it should be at least slightly rounded. On top of each side panel a 1-in. strip is pivoted to serve as a supporting arm when the leaves are raised to a horizontal position. They bear against the underside of both the leaf and table top and afford a very secure surface.

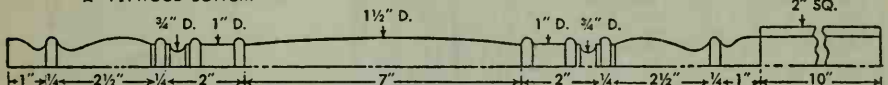
The drawer runners should be assembled before they are screwed in place. A side strip is nailed to the back of each runner, and acts as a guide for the drawer, thus preventing excessive side movement of the

drawer itself. The position of this guide strip is shown in place in the cutaway view of Fig. 2. Overall dimensions for the top drawer are given in Fig. 2. The lower drawer is similar, except that it is 1 in. deeper. Fig. 3 shows two methods of constructing the drawers. The one in the right-hand detail is of stronger construction, but the one in the left-hand detail is easier to make as there are no grooves required for the bottom, which projects beyond the side to work against the guide strips on the drawer runners. The right detail shows how the bottom is set into grooves in the sides and ends to provide more rigidity. Spacer strips nailed to the sides work against the runner guide strips.





③ ALTERNATE METHODS OF DRAWER CONSTRUCTION



④ DETAIL OF TURNED LEG, 4 REQUIRED

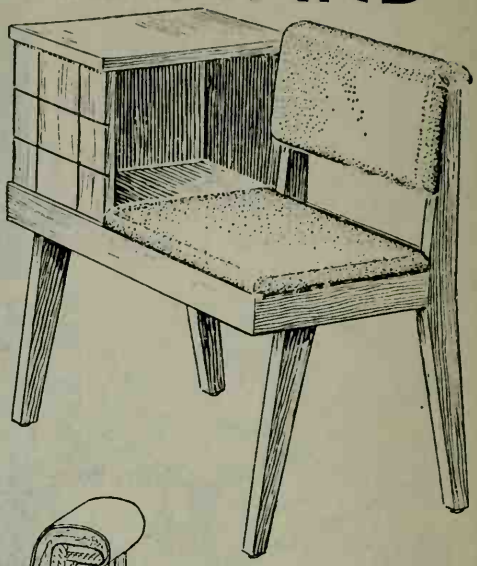
TELEPHONE STAND

Framed Opening in Partition Wall Forms Telephone Shelf

To save steps when answering the telephone, one homeowner has built this "window" between the kitchen and living room of his home by cutting through the partition wall between studs and framing the opening. The window trim matches the woodwork in the room in which it faces. To close the window and prevent cooking odors from entering the living room, a sliding panel could be installed if desired and a wide sill for a note pad can be included.

TELEPHONE STAND

Once again from the drawing board of the noted furniture designer, John Bergen, comes an outstanding piece of modern furniture for the home craftsman. This gossip bench has pleasingly simple lines and, more important, equally simple details of construction. Cabinet plywood is used on the exterior surfaces, and the craftsman has a wide selection of veneers from which to choose. In the detail the seat is on the right side of the bench, but this can be reversed if necessary. All edges contacting the upholstery are rounded, and two layers of cotton are used to pad the bench



LIST OF MATERIALS

Cabinet Plywood

1 pc.—¾" x 16¾" x 12"—Top
1 pc.—¾" x 11¾" x 9¼"—Front
1 pc.—¾" x 16¼" x 9¼"—Side
1 pc.—¾" x 11½" x 9¼"—Back
1 pc.—½" x 15½" x 11½"—Shelf

Fir Plywood

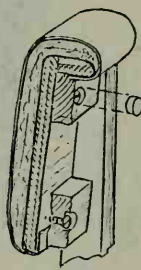
1 pc.—½" x 14½" x 20"—Seat
1 pc.—½" x 7" x 20"—Back
1 pc.—½" x 13⅜" x 20"—Top back

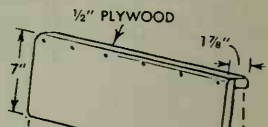
Lumber

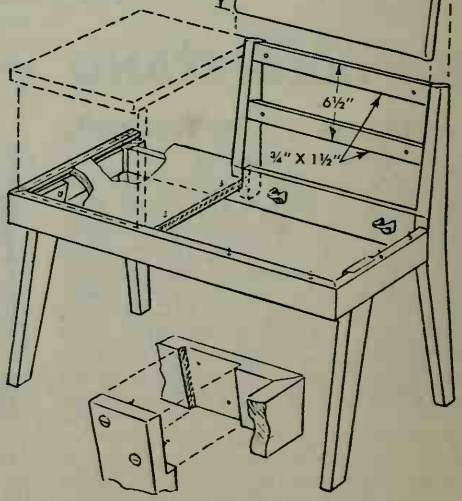
1 pc.—¾" x 2½" x 32"—Front rail
2 pcs.—¾" x 2½" x 14½"—Side rails
1 pc.—¾" x 3¾" x 30"—Back rail
2 pcs.—1" x 2¾" x 16¾"—Front legs
1 pc.—1" x 3½" x 26¾"—Back post
1 pc.—1" x 2¼" x 12¾"—Back post
1 pc.—1" x 3½" x 16"—Back leg
2 pcs.—¾" x 1½" x 18"—Back rails

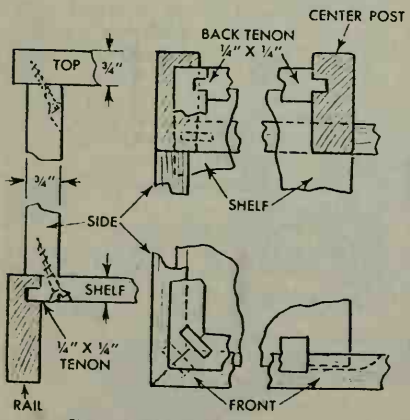
Miscellaneous

1½ yd. 27" wide upholstery cotton
½ yd. 54" wide upholstery cover
4⅝" dia. glides
1¼" dia. dowel

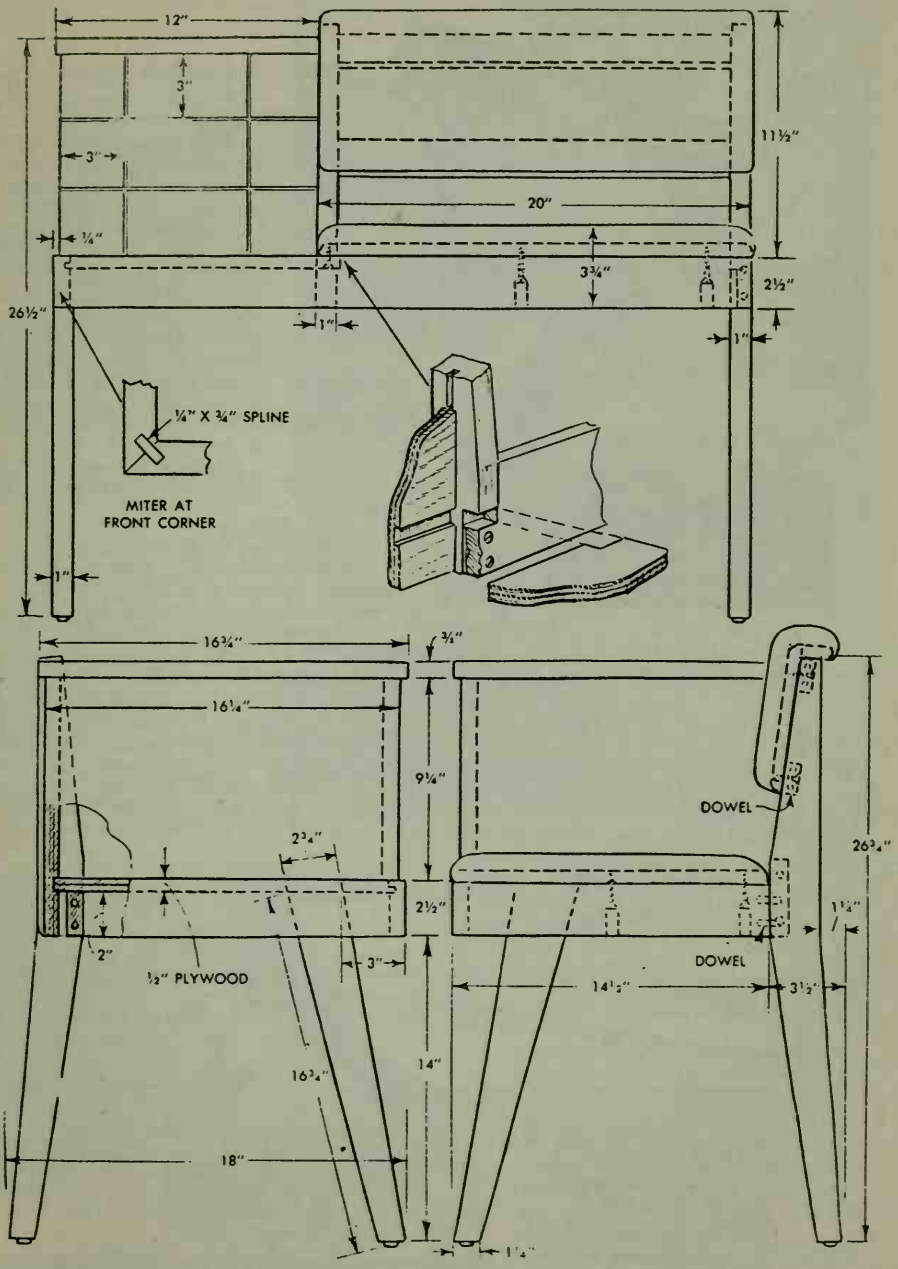








PLAN OF TELEPHONE DESK


12"
3"
3"
¼"
20"
11½"
3¾"
2½"
26½"
1"
1"
¼" X ¾" SPLINE
MITER AT
FRONT CORNER
1"
16¾"
¾"
16¼"
9¼"
DOWEL
26¾"
2¾"
2½"
1¼"
2"
½" PLYWOOD
3"
DOWEL
14½"
3½"
16¾"
14"
18"
1¼"

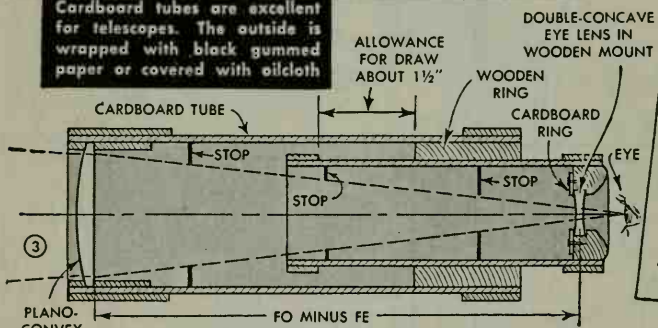
TELESCOPE DESIGN AND CONSTRUCTION

MAKING distant objects appear close by looking through pieces of curved glass is always thrilling, but the enjoyment is increased when you peer through a telescope that you yourself have made. The cost of making a telescope is especially low now because war-surplus stocks of perfect and chipped-edge lenses and prisms are available at low prices. You can make a good scope for as little as one dollar, and a really good terrestrial telescope for only three to five dollars for lenses.

Kinds of telescopes: Telescopes are divided into two

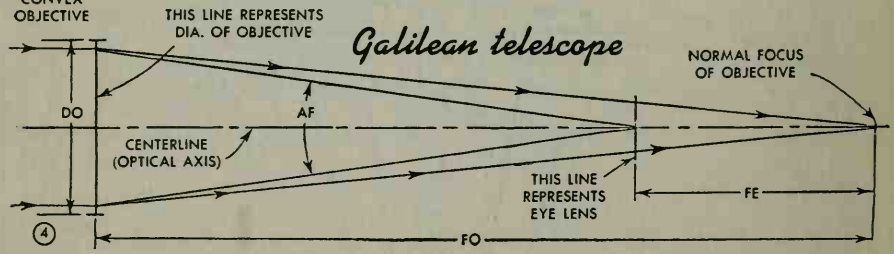
Tubing

Cardboard tubes are excellent for telescopes. The outside is wrapped with black gummed paper or covered with oilcloth



ABBREVIATIONS

M —Magnification
FO —Focal length of objective lens
DO —Diameter of objective lens
FE —Focal length of eye lens
AF —Apparent field
TF —True field
EP —Exit pupil
MM.—Millimeter (25 mm.=1" approx.)



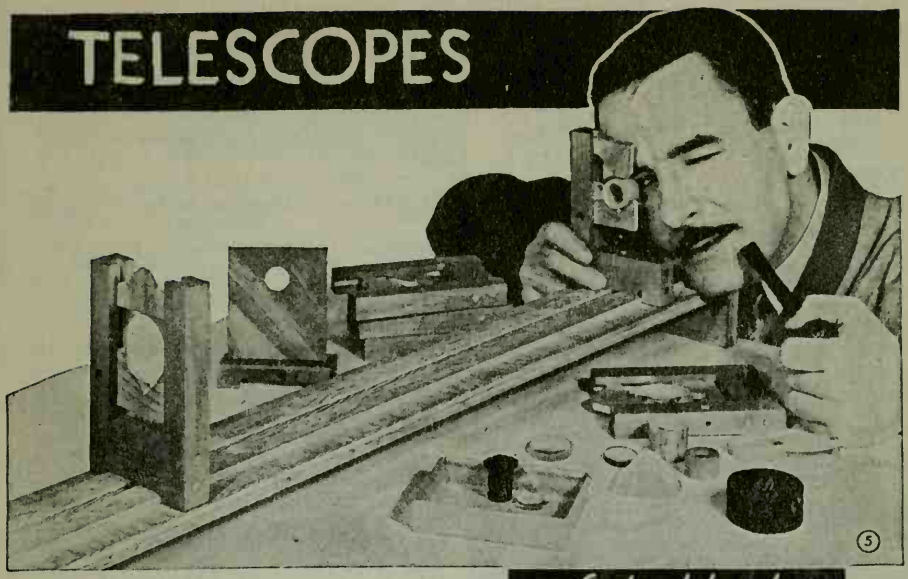
NORMAL VALUES

M—4 to 7X, top limit about 12X
DO and FO—Value of f/4 to f/6
FO—5" to 10" (127 to 254 mm.)
DO—1" to 2½" (25 to 64 mm.)
AF—About 16° TF—2° to 4°
FE—1" to 2" (25 to 50 mm.)
DIA. OF EYE LENS—Any small size—⅜" to ¾" dia.
EP—Galilean telescope has no exit pupil

CALCULATIONS

M=FO÷FE
AF—Measure angle on layout
TF=AF÷M
f/number of objective=FO÷DO
FE=FO÷Desired M
Field in yards at 1000 yards $= \frac{DO \times 1000}{FO \times M}$

TELESCOPES



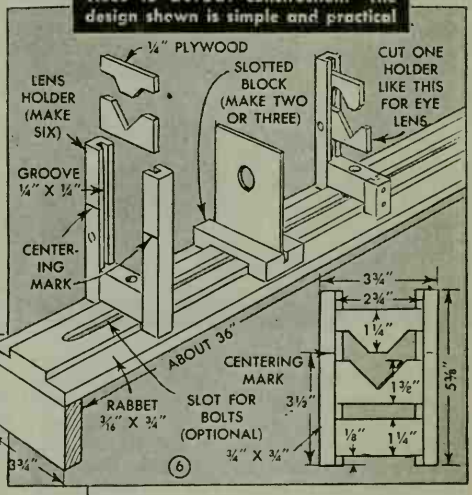
main classes, reflectors and refractors. The reflector uses a mirror to pick up the image while the refractor uses a lens. This article deals exclusively with the refractor type. A refractor used for viewing heavenly bodies is called an astronomical telescope. It shows the image upside down, but this makes little difference when you are looking at a star. Telescopes for viewing objects on land show an upright image and are called terrestrial telescopes. These include various types, such as the Galilean, riflescope, spotting scope, monocular and just plain "telescope" or spy glass.

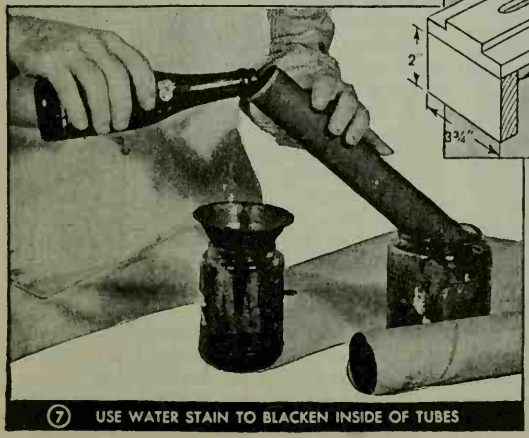
Galilean telescope: This scope is different from all others in that it has a negative lens for an eyepiece. Good features are simple construction, a clear, crisp field and an upright image. The one poor feature is that the field of view is small and decreases rapidly with increases in magnification. Hence, as made today, Galilean telescopes usually are confined to 6X or less.

Figs. 3 and 4 show the general construction and layout. Before

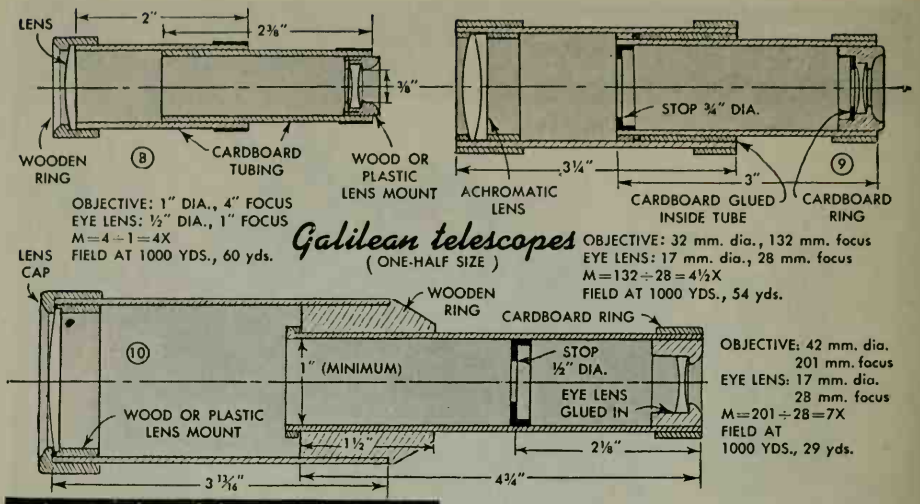
Optical bench

Some kind of bench is almost a necessity for checking lens systems previous to actual construction. The design shown is simple and practical





⑦ USE WATER STAIN TO BLACKEN INSIDE OF TUBES



Typical galilean telescopes

These designs show general construction. An achromatic objective lens is always an improvement. The scopes here are drawn as focused on an object at 18 ft. distance

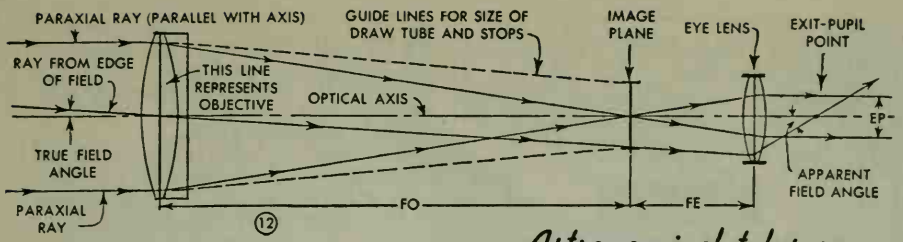
⑪ GLARE-STOPS PREVENT INTERNAL REFLECTIONS

you study this, learn the abbreviations given in Fig. 2, and always read the symbols as full words. It is best to use normal values as given in Fig. 4 when designing your scope, particularly where the f/value of the objective lens is concerned. You will understand quickly that to get a large field with a Galilean telescope you would need a large-diameter objective. Specific instruments are diagrammed in Figs. 8, 9 and 10. These are shown set up at about an 18-ft. focus, whereas Fig. 4 shows the lens spacing at infinity. Focused at infinity means focused for a distant object, usually 300 to 400 yards away. Your telescope is at its shortest draw when focused at infinity. You will have to allow an extra half-inch or so on the draw so that you can focus on near objects. The whole range of focusing from near to far objects is about ½ in. with the average objective, as most of the draw-tube travel is simply a matter of making the telescope as compact as possible. Glare stops prevent internal reflections. You can determine the diameter of these at any point from the AF lines, Fig. 4. One glare stop is enough for the Galilean. This can be made from cardboard with tabs turned over as in Fig. 11, pushed inside the draw-tube and fastened with a dab of glue.

Optical bench: An optical bench is handy for checking any lens system and almost a "must" when you get into five and six-lens systems. The design shown in Figs. 5 and 6 is simple and satisfactory. If you want to make a simpler setup, use a plain board and mount the lenses with modeling clay or wax on small blocks of wood. Test setups can be made indoors at about 18 ft., focusing on printed matter. Have a good light on the copy, but avoid light on the optical bench.

Tubing: Cardboard tubing is satisfactory for all telescopes. Select sturdy tubes of good wall thickness. Use a black water stain or flat black lacquer to blacken the inside of the tubes as in Fig. 7. Cover the outside with black gummed tape, spiral-wound as in Fig. 1. Oilcloth, canvas or imitation leather in plain wrap-around style also makes a neat outer covering. A metallic-silver or bronze paper makes an ideal covering for the draw tube.

Astronomical telescope: The astronomical is different from the Galilean in that it has a real image inside the telescope, and the eye lens is positive instead of negative. The layout for the astronomical telescope, and the table giving normal values and simple calculations, are shown in Fig. 12.



Astronomical telescope

NORMAL VALUES

DO: 1½" and up. f/10 to f/15
FO: 20" and up
FO: 10 to 15 times DO
M : 15 to 60 times DO
EP : ¼" to ⅛"
FE : ¼" to 1"
AF : 40°
TF : ½° to 2°

CALCULATIONS

M=FO÷FE
M= DO÷EP
EP=DO÷M
FE=FO÷M
TF=40°÷M
f/VALUE OF OBJECTIVE =FO÷DO
FIELD IN YDS. AT 1000 YDS. } Read two right figures from table

(13) SIZE OF IMAGE

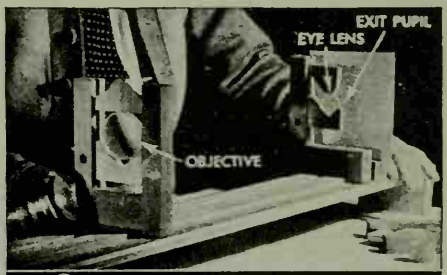
Find figure opposite magnification and multiply this factor by focal length of objective lens

M	Factor	M	Factor	M	Factor
20X	.035	35X	.020	50X	.014
25X	.028	40X	.017	60X	.012
30X	.023	45X	.015	70X	.010

Select your lenses and make a layout as in Fig. 12, checking this directly from the actual setup as made on the optical bench. Determine the image size from table Fig. 13. The pair of paraxial rays will pass through the center of the image and continue until they strike the eye lens, from which they emerge parallel, as shown. The ray from the edge of the field will pass through the center of the objective and the edge of the image and continue until it strikes the eye lens. This is the most important ray to consider. If you can get this through the telescope, the hundreds of other rays from the object viewed will automatically get through. Note that the eye lens must be big enough to catch this ray.

Exit pupil: Stand back about a foot from the eye lens and look at it. You will see a round dot of light in the center. This is the exit pupil of the telescope. Actually, it is an image of the objective lens. Now put a piece of paper or ground glass behind the eye lens and move it back and forth until you get the smallest and sharpest circle of light, Fig. 14. This location is the exit-pupil point and it marks the proper location of the eye. Noting its position from the eye lens, complete your layout drawing as in Fig. 12, continuing the ray from the edge of field through the exit-pupil point. Look again at your test setup and note how large the exit pupil is. A big exit pupil means good illumination; a small exit pupil, poor illumination. Since the astronomical telescope is used for viewing a light source, the matter of illumination is not so important, and the exit pupil can be as small as 1/64 in.

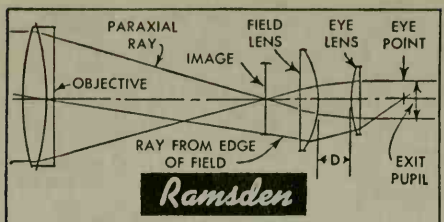
Experiments: While you have the astronomical telescope set up on the optical bench, make a few experiments. Remove the eye lens. Put a piece of ground glass or



(14) CHECKING EXIT-PUPIL SIZE AND POSITION

waxed paper at about the position of the image plane and move it back and forth until you get a sharp image. The image received in this manner covers a very wide field, much more than you can see through the eye lens. Now, in place of the ground glass put a piece of printed matter in the image plane. Place the eye lens in position and move it back and forth until the copy is sharp. The image is just the same as a solid piece of copy, and the purpose of the eye lens is to magnify it.

Eyepieces: There are better eyepieces than the single lens. The three common styles in use are shown in Figs. 15 to 19 inclusive. The Ramsden is the easiest to calculate and make; at the same time it is one of the best types of construction, giving a good field without distortion or other faults. The Kellner, Fig. 17, is a slight improvement on the Ramsden. The Huygenian, Fig. 18, is an old reliable, still popular. It differs from the Ramsden in that the image plane is behind the field lens. This style cannot be used directly as a magnifier. It has shorter eye relief (distance from eye point to eye lens) than the Ramsden, a point worth remembering when you are trying to get shorter or longer eye re-



Ramsden

CONSISTS OF TWO PLANO-CONVEX LENSES OF SAME FOCAL LENGTH, SPACED APART AT DISTANCE D, WITH CURVED SURFACES FACING

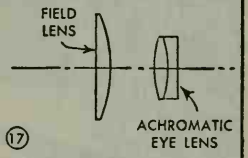
(15)

CALCULATIONS	EXAMPLES
D=TWO-THIRDS OF FOCAL LENGTH OF INDIVIDUAL LENS	33 MM. FOCUS — D — 33 MM. FOCUS $D=\frac{2}{3}\times\frac{11}{33}=22$ MM.
COMBINED FOCUS OF BOTH LENSES $=\frac{F\times F}{F+F-D}$	$FE=\frac{33\times 33}{33+33-22}=\frac{1089}{44}=24$ MM.

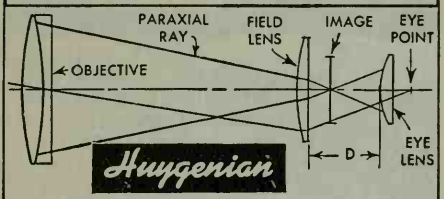
(16)

Kellner

SAME AS RAMSDEN EXCEPT IT HAS A CEMENTED DOUBLET ACHROMAT AS EYE LENS. CALCULATIONS ARE SAME AS FOR RAMSDEN



(17)



Huygenian

CONSISTS OF TWO PLANO-CONVEX LENSES WITH CURVED SURFACES FACING OBJECTIVE. FOCAL LENGTH OF FIELD LENS IS TWO TO THREE TIMES FOCAL LENGTH OF EYE LENS

(18)

CALCULATIONS	EXAMPLES
D=ONE-HALF OF COMBINED FOCAL LENGTHS	60 MM. FOCUS — D — 20 MM. FOCUS $D=\frac{60+20}{2}=\frac{80}{2}=40$ MM.
COMBINED FOCUS CALCULATED SAME AS RAMSDEN	$FE=\frac{60\times 20}{60+20-40}=\frac{1200}{40}=30$ MM.

(19)

Eyepiece designs

Two lenses combined form an eyepiece and give better results than a single lens. Most popular style is the Ramsden although the Huygenian is an old favorite, especially for astronomical telescopes. The mounting can be wood, metal or plastic, turned to shape

lief. Of the two lenses in any eyepiece, the eye lens is the most important as it controls distortion and magnification much more than the field lens. The prime purpose of the field lens is to pick up the light rays from the edge of the field.

The combined focus of the two lenses in the eyepiece is determined by the calculations given in Fig. 16. The example in Fig. 16 shows that a 33-mm. field lens and a 33-mm. eye lens spaced 22 mm. apart will have a focal length of approximately 24 mm. This is not quite the same thing as a single 24-mm. focus lens. When you hold the single 24-mm. focus lens to your eye, you are sharply focused on any image or copy when the lens is 24 mm. away from the image or copy. In the combined lenses you will find the focal plane just a little ahead of the field lens because the 24-mm. focal length is measured from a point between the two lenses. As a matter of fact, the best correction of the combined lenses is obtained when the focal plane is exactly in the plane of the field lens. This means, however, that the field lens is sharply in focus; hence, you can see every speck of dust on it. When you note this condition, your lenses are spaced too far apart. Close them up until the dust specks disappear.

The image stop: The image stop is a round disk of cardboard placed in the image plane. The size of the hole is determined from Fig. 13; also, you can get a good idea of size by viewing a ruled piece of paper through the eyepiece. The image plane formed by the objective and the focal plane of the eyepiece always indicate the same plane when the telescope is focused. This stop is important because it clearly defines the field of view, cutting out weak edge rays and giving a sharp, clean-cut image. It is commonly made a part of the eyepiece, being located between the lenses in the Huygenian and ahead of the field lens in the Ramsden or Kellner. It should be dead sharp as viewed through the eye lens and, when the telescope is focused, it will always coincide with the image plane.

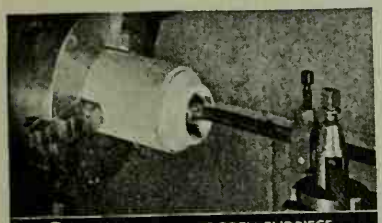
A typical astronomical telescope: Typical construction of a simple astronomical telescope is shown in Figs. 20, 21 and 22. This has a 2⅜-in. diameter objective (2¼ in. clear) and the focal length is 36 in. A draw tube is used for rough focusing; critical focusing is done with a 40-pitch threaded eyepiece. The eyepiece is a Ramsden and can be of ¼ to 1-in. focus. With a ½-in. eyepiece, the magnification would be 72X; with a 22-mm. eyepiece, the magnification would be 41X. Magnification could be pushed up to 144X with a ¼-in. eyepiece. The exit pupil then would be about 1/64 in., representing about the limit for astronomical use.

Even though you may not wish to build an astronomical telescope, carefully study the drawings and text covering this subject as they are the basis for all terrestrial telescopes. You will need all this data in order to make the popular hand telescope or spy glass.

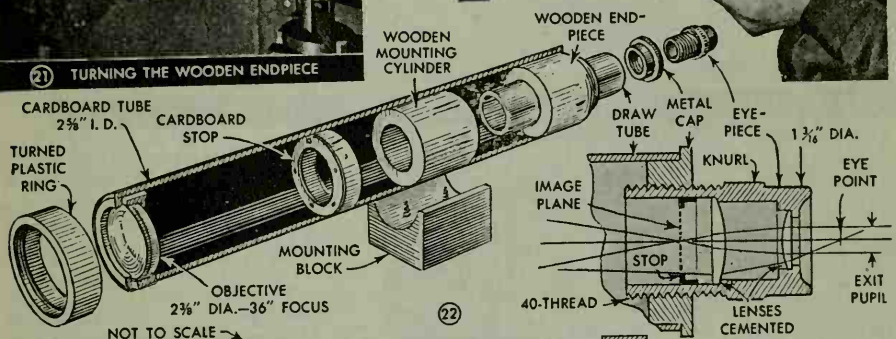
Astronomical telescope

This one will magnify up to 144X. It can be fitted with prismatic eyepiece and used at 40X for viewing objects on land

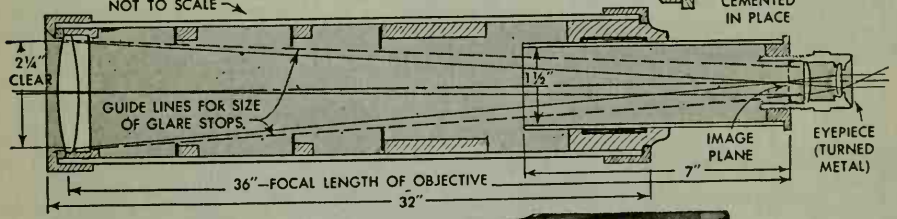
(20)

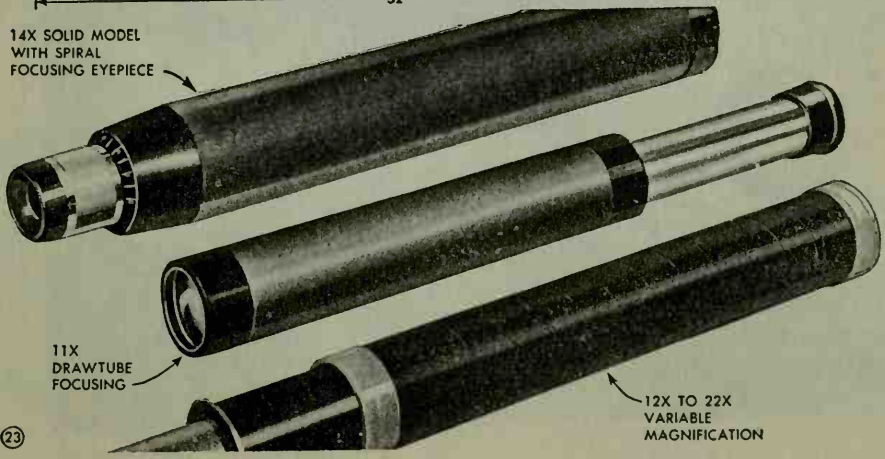


(21) TURNING THE WOODEN ENDPIECE



(22)



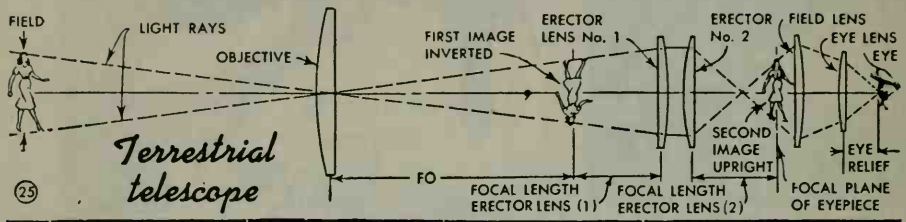


(23)

(24)

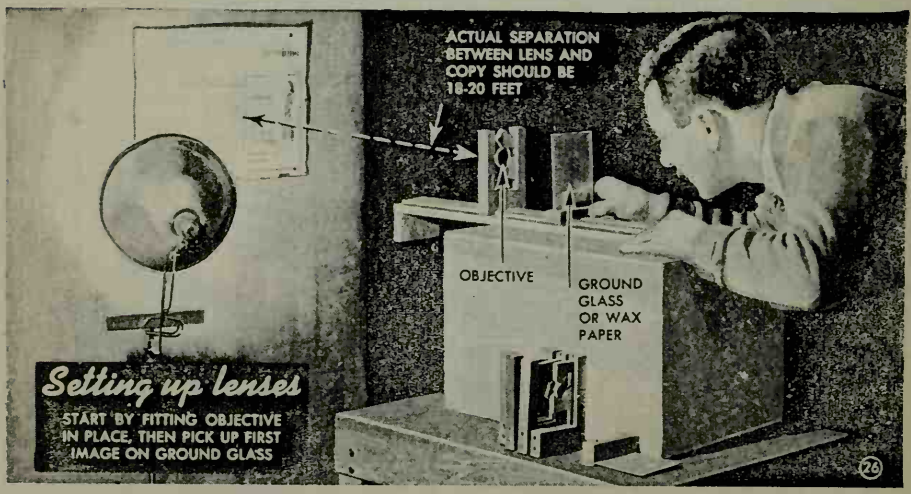
IMAGE SIZE (40° APPARENT FIELD)			
M	Factor	M	Factor
8X	.087	17X	.042
9X	.077	18X	.038
10X	.070	19X	.036
11X	.063	20X	.035
12X	.058	21X	.033
13X	.054	22X	.031
14X	.049	24X	.029
15X	.047	26X	.026
16X	.044	28X	.024

Normal lens system: This also is shown in Fig. 25. The field lens and eye lens making up the eyepiece are the same as for the astronomical telescope, and



(25)

	CHARACTERISTIC	NORMAL VALUE	HOW CALCULATED	EXAMPLE: 11X (from text)
1	Equivalent focus of objective	1 to 3 times focal length of objective	FO times erector magnification	132 × 2 = 264 mm.
2	Erector magnification	1X to 3X	E-2 ÷ E-1	80 ÷ 41 = 2X
3	Magnification	13 times DO (in inches)	FO or equivalent FO divided by FE	264 ÷ 24 = 11X
4	First image size	¼" to ¾"	Value from Fig. 24 times FO	.063 × 5.18 = .326 = 5/16"
5	Exit pupil	2 to 5 mm. (1/16" to 3/16")	DO ÷ M	32 ÷ 11 = 3 mm.
6	Eye relief	¾" (min.) to 1"	Measure direct	⅝" scant
7	Luminosity	10 to 100%	$(DO \div 5)^2 \div M^2$	$(32 \div 5)^2 \div 11^2 = 36 \div 121 = 30\%$
8	Field in yds. at 1,000 yds.	10 to 90 yards depending on magnification	Read value from Fig. 24 as yards (see text)	63 yards (see text)

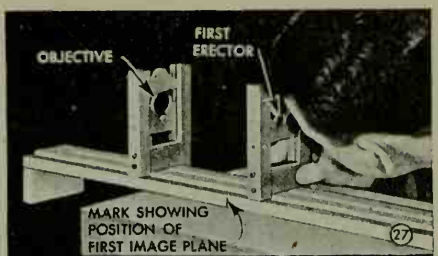


(26)

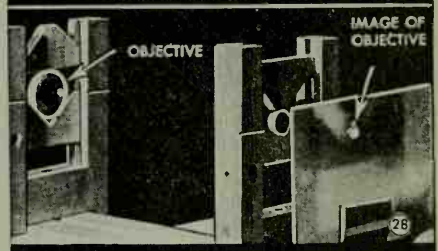
can be Huygenian, Ramsden or Kellner as previously described. The one shown here is a Ramsden. The eyepiece together with the two erectors make an erecting eyepiece, and all four lenses are mounted at a fixed spacing in the draw tube. Fig. 25 shows erectors of equal focal length, spaced at their focal lengths from the two image planes. With this setup, the erectors give unity magnification; that is, they add nothing to the magnification of the system.

Designing your own scope: The best way to make a scope is to design and test your own. First, select suitable lenses, Fig. 32, and run through the simple calculations and other data. Then make a layout, tracing the light rays and, at the same time, check the system on the optical bench. This procedure, using tne 11X scope shown in Fig. 23 as an example, will be described in detail. Preliminary calculations are given in the right-hand column of the table.

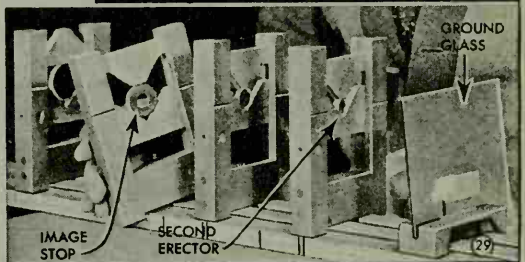
Making the layout: Start the layout as in Fig. 30, drawing a centerline and a line indicating the diameter of the objective. Set up the objective on an optical bench, with test copy about 20 ft. away. Take a piece of ground glass and pull it back from the objective until you get the image in sharp focus, Fig. 26. This image marks the first image plane. Measure the distance from objective to image plane and make a corresponding line on your layout. Next, set up the first erector lens and move it back and forth



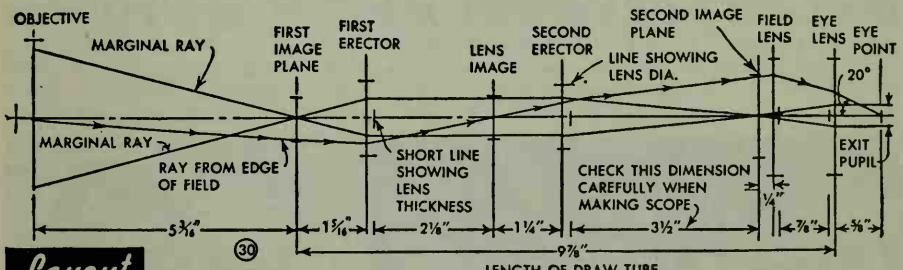
FOCUSING THE FIRST ERECTOR LENS



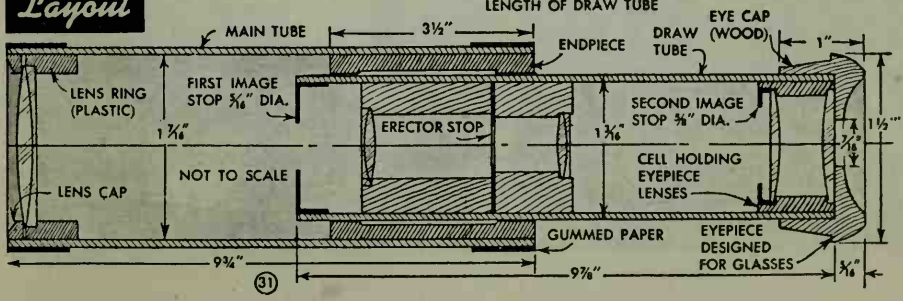
LENS IMAGE PICKED UP ON GROUND GLASS

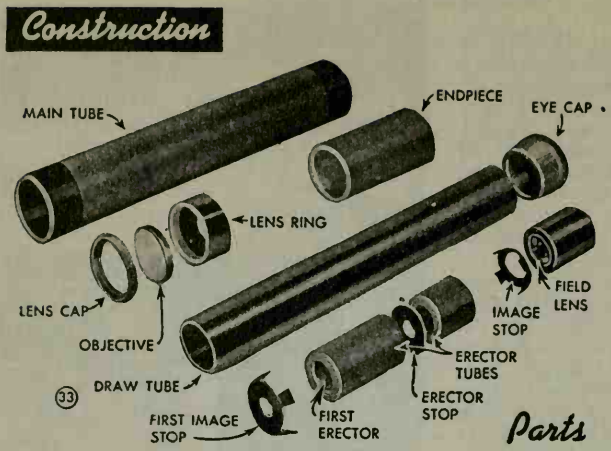


FIT SECOND ERECTOR . . . FIND SECOND IMAGE PLANE



Layout





32 **Lenses**

	Inches		MM.	
	Dia.	F.L.	Dia.	F.L.
Objective	1¼	5 3/16	32	132
E-1	5/8	1 5/8	15	41
E-2	½	3 1/16	12	80
Field	7/8	1 5/16	22	32
Eye	7/8	1 5/16	22	32

See right col. Fig 25 for other data

11× Terrestrial

This typical scope, ideal for hunting or observation, is used to show method of setting up and checking lens systems

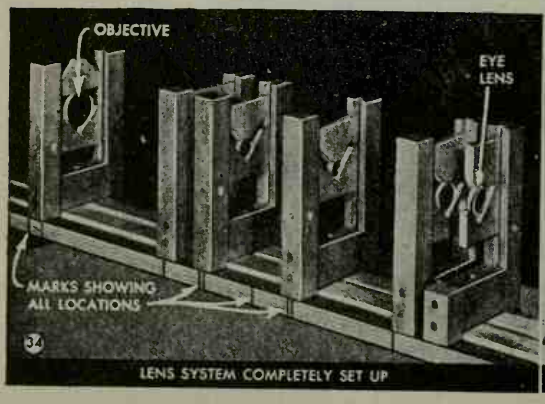
until you get the copy in sharp focus, Fig. 27. Then measure the distance from image plane or objective and mark on the layout.

Size of image: Find 11X magnification in Fig. 24, and opposite this read the factor, .063. Apply calculation No. 4, Fig. 25; the answer is 3/16 in., which is the size of the image at the first image plane. Mark the diameter on the layout.

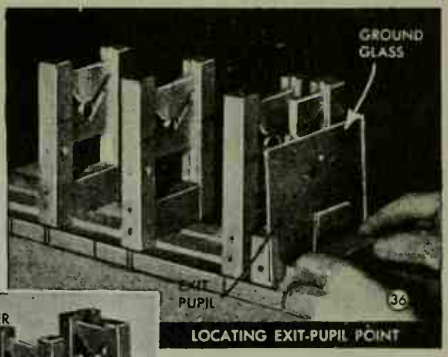
Tracing the light rays: Now, you can draw the light rays from objective to first erector, Fig. 30, using only three rays to represent the extremes, thus embracing all of the many light rays which pass through the telescope. The pair of marginal rays comes to a focus at the center of the image plane and continues until it strikes the first erector. The other ray is from the extreme edge of the field or picture and will pass through the extreme edge of the same "picture" inside your telescope. The erector lens must be large enough to receive these rays.

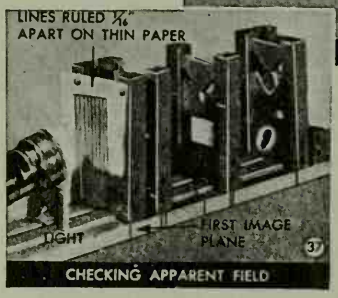
Close or spaced erectors: Here you have to decide whether you want the erectors close together or spaced well apart. Either way is suitable. Close spacing has an advantage in compactness, but it also requires longer eye relief. Therefore, it is best to space the erectors farther apart in order to shorten eye relief.

Lens image: In wide spacing, there will be an image of the objective lens between the erectors, and in close spacing, the image will be behind the second erector. The next step is to find this lens image. Use the ground glass and move it up behind the first erector until you get a circle of



light in sharp focus as in Fig. 28. This is the lens image. Mark its size and position on the layout. Continue the light rays. The marginal rays are parallel with the centerline. Note that since they originally passed through the edge of the objective, they now will pass through the edge of the objective image. Similarly, the ray from the edge of the field, which originally passed through the center of the objective, now passes through the center of the objective image. These rays continue until they strike the second erector. To favor the small second erector, it is placed about 1¼ in. behind the lens image.

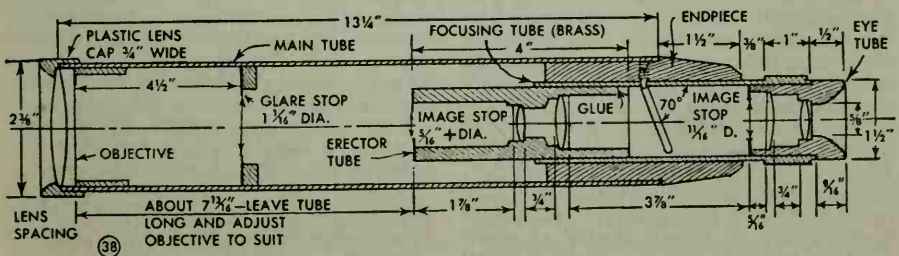




The second image: Put the ground glass behind the second erector and pull it back until you get a sharp image of the copy. This is the second image plane, and will be upright. Indicate its position on the layout and make a ring of cardboard with a central hole the same size as the first image, which is 5/16 in. Mount this disk at the first image plane as in Fig. 29. Since you are using 2X magnification through the erectors, the image on the ground glass at the second image plane should be about 5/8 in. in diameter. Mark the diameter on the layout. Set up the eyepiece and focus. Mark the position of field and eye lenses on the layout. Continue the light rays from the second erector, through the second image, to the field lens. Fig. 34 shows the complete setup on an optical bench. On the layout, you now work from the eye end to complete the ray tracing. Find the exit-pupil point, Fig. 36. Mark this point on the layout and draw a line from it to the eye-lens line at an angle of 20 deg. to the centerline. Connect this point on the eye lens with the end of the edge-of-field ray at the field lens. Measure the diameter of the exit pupil and draw lines parallel with the centerline, connecting them with the ends of marginal rays at the field lens.

Mechanical construction: This is shown in Figs. 31 and 33. Two tubes are used; one houses the objective and the other carries the erecting eyepiece. The hole in the eye cap is determined by the 20-deg. line on the layout. The depth of the eye cap should be such as to set the proper eye relief. The one shown is shallow for use with eye glasses. The scope as set up is focused at 20 ft., which represents the longest extension required.

Visual check of magnification: Make a visual test by looking through the telescope with one eye and directly at the copy with the other eye, Fig. 35. You will see the two views one over the other. Note sizes; that is, so many lines of copy as seen by scope covers the full sheet of copy as seen by eye. Now measure the two distances. In this particular case, 1¾ in. of copy seen through the scope covers the full height of



14× Spiral focusing

LENSES	Millimeters		Inches	
	Dia.	Focus	Dia.	Focus
Objective	52	193	2.04	7.60
Erector 1	18	49	.71	1.93
Erector 2	25	95	.98	3.74
Field	26	45	1.02	1.77
Eye	17	38	.67	1.49

Combined focus of eyepiece $\frac{45 \times 38}{45+38-19} = 27$ mm.

Erector magnification = 95 ÷ 49 = 1.9X

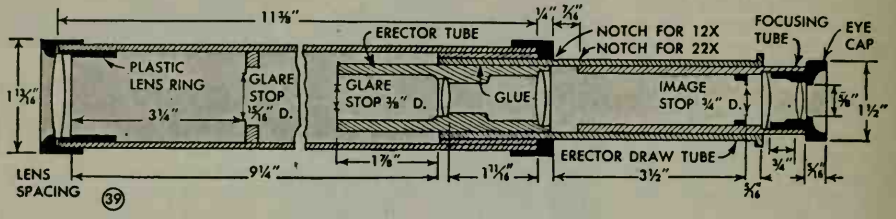
Equiv. focus of objective = 193X 1.9 = 367 mm.

Magnification = 367 ÷ 27 = 13½X

Luminosity = 59%

Field (actual) = 40 yds. at 1,000 yds.

TUBES	Dia.	Length
Main	2 1/16" I.D.	13¼"
Erector	1⅜" O.D.	4"
Endpiece	2¼" O.D.	3⅜"
Focusing	1⅜" I.D.	5⅜"
Eyepiece	1½" O.D.	1 13/16"



12× to 22× variable

LENSES	Millimeters		Inches	
	Dia.	Focus	Dia.	Focus
Objective	36	181	1.42	7.13

Other lenses same as scope at top of page. Various styles or powers of eyepieces can be substituted without affecting the general construction

Eyepiece: 27 mm. focus

Erector magnification: 1.9X

Equiv. focus of objective = 181X 1.9 = 344 mm.

Magnification = 344 ÷ 27 = 13X normal

Luminosity at 12X = 35%

Luminosity at 22X = 10%

Field (12X): 42 yds. at 1,000 yds.

Field (22X): 23 yds. at 1,000 yds.

TUBES	Dia.	Length
Main	1 11/16" O.D.	11⅜"
Erector	1⅜" O.D.	3⅞"
*Erector draw	1⅜" I.D.	6"
Focusing	1⅜" O.D.	4¼"
Eye cap	1½" O.D.	1¼"

*Plastic drain tube for lavatory (plumbing)

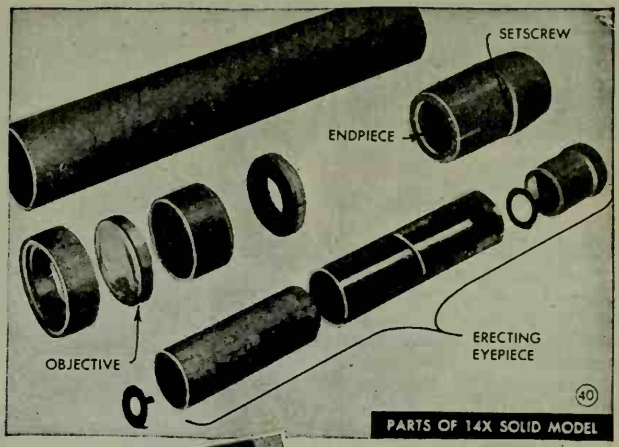
copy, 20 in. Then, 20 divided by 1.75 equals about 12X magnification.

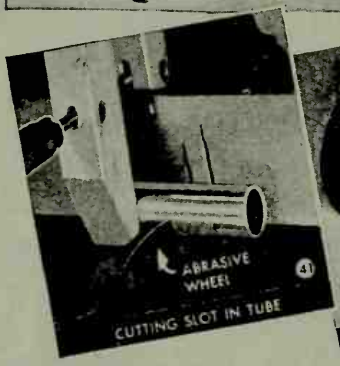
Visual check of field: The field is checked by measuring the width of copy you can see through the scope at 20 ft. Multiply this distance in inches by 4 to get the approximate field in yards at 1000 yards. In this case, the field at 20 ft. measures 14 in., so the field at 1000 yards will be 56 yds. This is a little less than the paper value as determined from calculation No. 8, Fig. 25. No. 8 calculation is based on maintaining a full 40-deg. apparent field, which is not always the case.

Visual check of apparent field: The apparent field angle is the extreme angle which light rays make on reaching the eye; the true field angle is the apparent field angle divided by the magnification. Values given in Fig. 24 take a 40-deg. apparent field for granted. You can make a visual check by ruling lines 1/16 in. apart on a sheet of tracing or other thin paper. Mount this at the first image plane and illuminate it from the objective side, Fig. 37. Count the number of lines you can see through the eyepiece. If the eyepiece is maintaining a 40-deg. field, you should see five lines. Less than this means you are not getting a 40-deg. field, the reason being that erector magnification at the second image plane makes the image too large to be viewed by a normal-size eyepiece. This merely means that the field of view will be somewhat reduced in size and calculation No. 8 cannot then be used.

Luminosity: In daylight, the pupil of your eye is about 5 mm. in diameter. Calculation No. 7, Fig. 25, gives light percentage and is based on 100 percent for a 5-mm. pupil. At night, the pupil of your eye dilates to about 7 mm. To find luminosity of any scope as a night glass, substitute 7 for 5 in the calculation.

Conjugate magnification: As described, erector magnification is obtained when the second erector is of longer focal length than the first. Another way of getting erector magnification is by setting up the lenses at distances other than their focal lengths. This works exactly like a camera. Consider the first image to be a solid object, such as a person's head. To get a large picture of this object, the camera lens is pushed close to it, at the same time extending the bellows. You do the same thing in a telescope by pushing the first erector closer to the first image plane. This gives a large second image at a distance farther back than the focal length of the second erector. A small amount of conjugate magnification usually is introduced when any lens system is set up by eye; you can deliberately introduce a great amount of magnification in this way. The 11X scope can be pushed up to 30X if desired. However, note that the second image is much too large to be viewed by the eyepiece, with the result that you lose field area, and the increase in magnification means less illumination. Conjugate magnification cannot be calculated by the simple rules given, but it is easily determined visually.



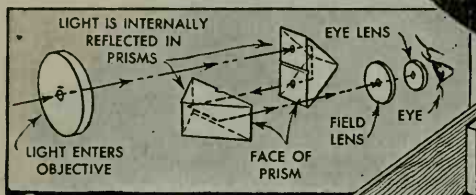


Specific designs: Dimensioned designs are impractical as there is no assurance that you can get tubes and lenses specified. However, such designs are useful as a general guide, and two are shown and briefly described. The first is a 14X spiral-focusing scope, as diagrammed in Fig. 38 and further illustrated by Figs. 23, 40, 41 and 42. It is a solid model and does not telescope. Using the short objectives described in this article, the whole range of focusing from 20 ft. to infinity is very short, averaging ½ in. or less of travel. Hence, it is practical to make a solid scope and confine the focusing to a threaded or spiral-focusing device. This one uses a spiral. It is cut about halfway across the focusing tube, which should be metal or plastic to have the required stiffness. The job is easily done on a circular saw, using an abrasive wheel, as shown in Fig. 41. A setscrew through the endpiece engages in this slot, permitting a travel of about ⅜ in. as the focusing tube is turned. The wooden tube in which erectors are mounted is a drive or glued fit inside the focusing tube. Lens spacing is about normal, so that the true magnification is equivalent to DO divided by FE, or 14X. The eyepiece is a modified Kellner, with field lens of slightly longer focus than eye lens.

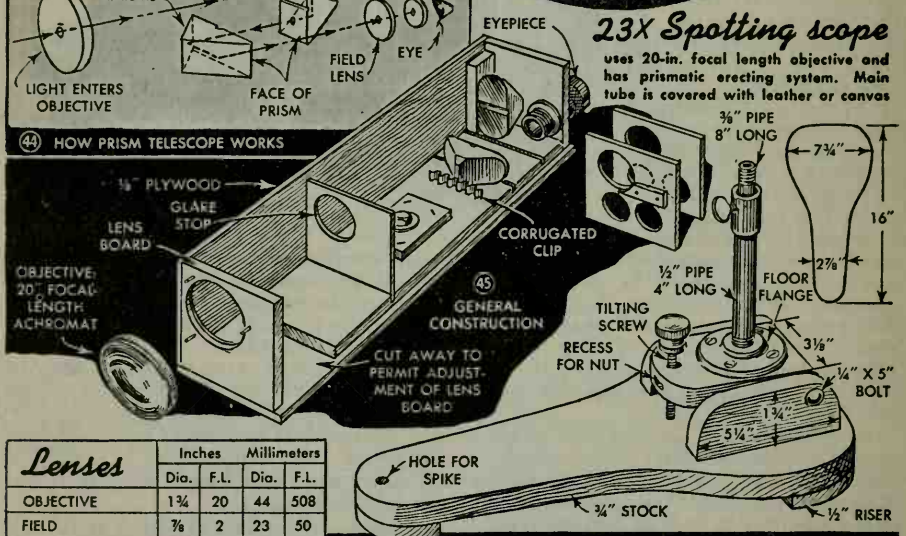
The second specific design, Figs. 23 and 39, features conjugate magnification. As previously described, high magnification is obtained by pushing the erectors close to the first image; at the same time it is necessary to extend the eyepiece a considerable distance to bring the object into focus. In this scope, the erector draw tube slides inside the main tube and the focusing tube slides inside the erector draw tube. Marks or notches on the erector tube indicate the setting for high or low magnification and the setting can be anywhere between these marks.

Design and Construction of TELESCOPES

THE prismatic telescope is an astronomical telescope plus a pair of prisms for erecting the image. The most common example of this type of construction is the binocular instrument. One half of a binocular is a monocular. Some telescopes are used for a specific purpose and are named accordingly, a typical example being a spotting scope, which is used to view the target in rifle shooting.



44 HOW PRISM TELESCOPE WORKS



46 MOUNT HAS HEIGHT AND ANGLE ADJUSTMENTS

Lenses	Inches		Millimeters	
	Dia.	F.L.	Dia.	F.L.
OBJECTIVE	1¾	20	44	508
FIELD	⅞	2	23	50
EYE	⅝	1⅛	16	28

Data (47)

EQUIV. FOCUS OF EYEPIECE $= \frac{28 \times 50}{28 + 50 - 15} = 22$ MM.

MAGNIFICATION $= 508 \div 22 = 23X$

EXIT PUPIL $= \frac{1}{16}" = 2$ MM.

EYE RELIEF $= \frac{7}{16}$ IN.

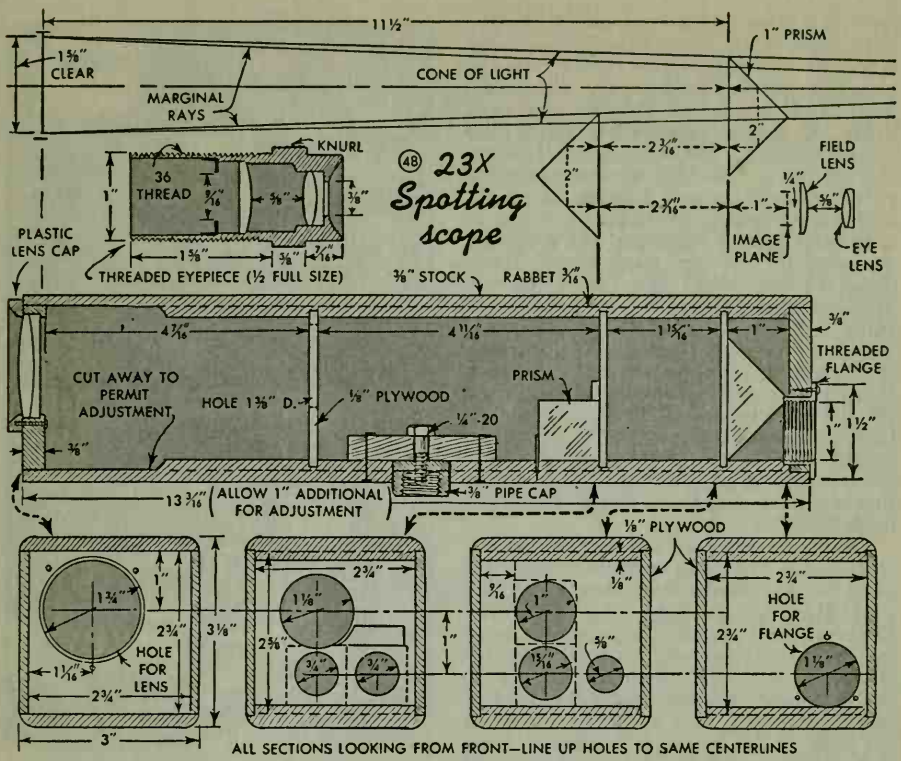
LUMINOSITY $= 13\%$

PRISMS—1-IN. FACE

IMAGE SIZE $= 20" \times .030 = .60" = \frac{9}{16}"$

FIELD OF VIEW AT 1000 YDS. $= 24$ YDS. (APPROX.)

Prisms: Prisms are polished, angular pieces of glass, the kind commonly used in telescopes being 45-45-90-deg. prisms. The long side is the face, while the two short sides are the reflecting surfaces. The size of the prism is the width of the face. Fig. 44 shows how the prisms are used in a telescope. Made specifically for telescopes, the prisms are grooved across the face in order to make a definite dividing line and avoid ghost images which would be caused by overlapping rays at this point. The ends are usually rounded to conserve space. The two sizes that you will probably work with



are 1 in. and 13/16 in. The 1-in. size is from the Navy 7X binocular while the smaller prism is from the Army 6X binocular. These prisms can be used in almost any power or type of prismatic telescope. The prime advantage of the prism erecting system is compactness. It adds somewhat to the bulk of the instrument but shortens the length considerably. The prism glass has an illusive quality of brilliance but actually the light loss through the two prisms is somewhat greater than through the two erecting lenses of a lens erecting system.

The 23X prismatic spotting scope: This design calls for a 20-in. focal length objective, which, with a 22-mm. focal length eyepiece (from Army 6X), gives 23-diameter magnification. Prisms are 1-in. face. Fig. 45 shows the general construction and Fig. 47 gives lens data, while Fig. 48 gives complete dimensions. The scope body is of wood construction in simple box form. The first prism, the one the light strikes first, is located in an upright position at the back of the box; the second prism is mounted flat on the box bottom. Plywood spacers hold the prisms in place and also provide for the passage of the cone of light admitted by the objective. The eyepiece is fitted in a threaded mount. This type of focusing is satisfactory at set distances but is much too slow for general use. If you want this scope for general observation, it should be fitted with spiral focusing like the 10X monocular to be described later. It would also be practical to focus with a simple draw tube system. The principal point of the construction is to get the various holes lined up square. Use prism center lines as a guide and locate all holes from one master pattern drawn on cardboard.

A mount for the spotting scope is shown in Figs. 43 and 46. The ⅜-in. pipe fits into a pipe cap recessed and bolted to the bottom of the telescope as can be seen in Fig. 48. The pipe slides inside the 4-in. length of ½-in. pipe to provide height adjustment from 11 to 17 in. to objective centerline. Base on which the floor flange is mounted pivots on a carriage bolt and is tilted by means of a tilting screw.

Designing prismatic telescopes: Designing your own prismatic telescopes follows much the same procedure as used for astronomicals and terrestrials. Primary consideration should be given the objective and eyepiece. The prisms contribute nothing to the magnification; therefore, the power

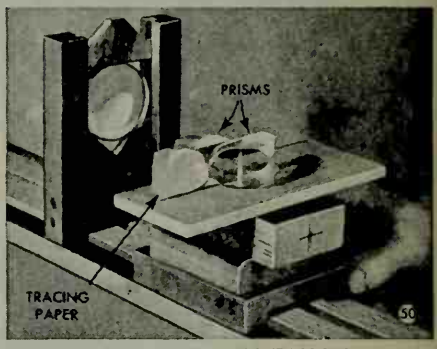
you want must be obtained entirely by the ratio of FO to FE. Prisms should be of such a size or so located as to receive the full cone of light from the objective, although it is practical to sacrifice extreme edge rays.

Fig. 52 shows the complete layout and construction of a 10X monocular. The layout (at top of drawing) is what you make to determine size and location of prisms and also the general overall dimensions. In this example, the objective has a 52-mm. diameter by 193-mm. focal length (from Navy 7X binocular) and the prisms are 1-in. face (from Navy 7X). As used by the Navy, this glass has a 27-mm. eyepiece, which gives a magnification of 7 diameters. If you want higher magnification, you have to use a shorter focus eyepiece. The Army 6X binocular eyepiece, 22 mm., could be used and would give you 9X. The eyepiece shown uses an Army binocular eye lens, but a shorter focus field lens, the combination giving 20-mm. focus, hence, about 10X magnification.

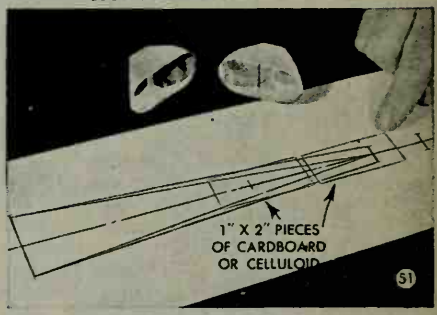
The preliminary calculation should determine the exit pupil and luminosity. This glass has excellent illumination at 92 percent. However, don't get the idea that the 13 percent rating of the 23X spotting scope is hopeless—13 percent is a good value for anything over 20X magnification. It is worth mentioning here that prism instruments are often rated for illumination on the basis of the exit pupil squared. Thus, if the scope has a 5-mm. exit pupil, it would be rated 25. Using this calculation, the 100 percent standard would be the normal size of the eye pupil, squared: 25 for daylight and 49 for night.

Bench setup: Set up the objective and focus on well-lighted copy or a bare light bulb, not less than 20 ft. from lens. Use tracing or waxed paper as a ground glass to pick up the image as in Fig. 49. Measure the distance from the rear side of the objective to the image plane. Start your layout and transfer this dimension to the layout, as indicated by A, Fig. 52. Next, put the two prisms face to face as in Fig. 50 and move the assembly back and forth until you pick up a sharp image of the copy or light bulb. Measure the distance to the face of the first prism and set off this distance on your layout, indicated by B, Fig. 52. Now, referring to the Fig. 48 layout, you will note that the distance the light travels through a 1-in. prism is 2 in., a total of 4 in. for both prisms. Set off this distance, C, on your layout to establish the back image plane. Determine the image size. In this instance, the multiplying factor is .070, and this figure multiplied by the focal length of the lens (7⅝ in.) gives .53 in. for the image size. Call this 9/16 in. for an even figure and mark the image size at

PICK UP IMAGE ON TRACING PAPER

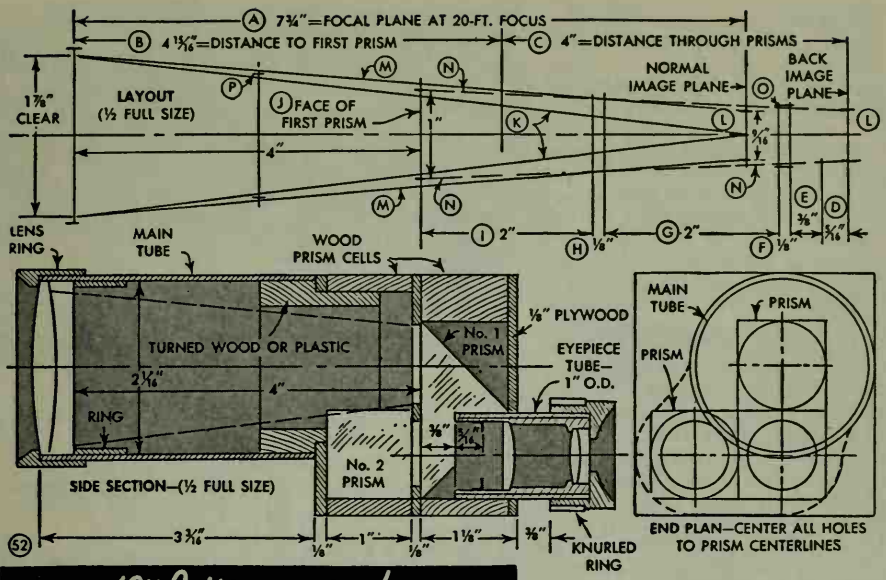


LOCATE IMAGE PLANE WITH PRISMS



MAKE LAYOUT AND MANIPULATE PRISMS TO SUIT

the normal image plane and again at the back image plane, as indicated by L, Fig. 52. Draw lines K and M representing the marginal rays and the full cone of light. Your prisms must catch the marginal rays K and also as much of the weaker edge rays as possible. The best way to determine prism placement is to make two 1 by 2-in. oblongs of cardboard or celluloid. Manipulate these over your layout as in Fig. 51. The forward edge of the first oblong represents the face of the first prism. You can tell at a glance how far forward you can push it and still pick up the marginal rays.



10× Prism monocular

OBJECTIVE: 52X193 MM.	M=193÷20=10X
PRISMS: 1"	EP=3/16" STRONG=5 MM.
FIELD LENS: 21X32 MM.	EYE RELIEF: 7/16"
EYE LENS: 16X25 MM.	LUMINOSITY: 92%
COMBINED FOCUS OF EYEPIECE $=\frac{25\times32}{25+32-16}=20$ MM.	FIELD (From Fig. 24): 70 YDS.
	FIELD (Actual): 62 YDS.
	WEIGHT: 1 LB.

The distance between the two oblongs is the spacing between the prisms. The distance between the back edge of the second oblong and the back image plane must be sufficient to permit focusing. What you finally arrive at in this case is D, 5/16-in. allowance for the distance the image plane will set inside the eyepiece tube; E, 3/8 in. for focusing travel; F, 1/8-in. prism spacing; G, 2 in., the distance through the second prism; H, 1/8-in. prism spacing again, coming back; I, 2 in. for the first prism, arriving at J, the face of the first prism. This may sound complicated, but it is really very simple if you are actually on the job. If desired, you can now draw an outline of the prisms like Fig. 48. This shows both prisms flat, the same way you test them in the bench setup.

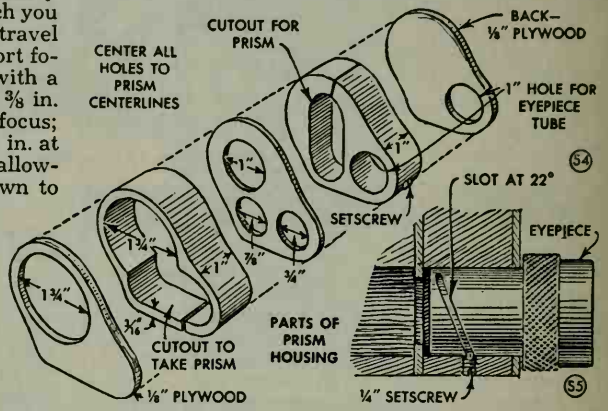
At this point J, it will be noted that the face of the prism catches all of the marginal rays and about halfway out to the lines representing the full cone of light. As mentioned before, it is practical to sacrifice some or all of the weak edge rays, so that this placement of the first prism face is quite satisfactory. What next? Well, you know that the maximum cone of light you can catch on the first prism is 1 in. in diameter at J, so lines drawn from here to image size at the back image plane will establish guide lines for hole diameters needed to pass this same cone of light back to the image plane. These lines are marked N in the drawing, and O, for example, shows the diameter of the hole at the back face of the second prism. If you want to use one or more glare stops ahead of the prisms, the hole diameters are determined in the same way, as at P.

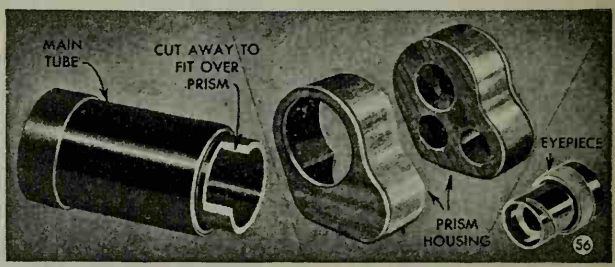
Monocular construction: You will need two wood blocks exactly 1 in. thick to house the prisms, Fig. 54. The 1/8-in. spacing between prisms is taken up by a spacer of 1/8-in. plywood, and similar plywood pieces are used at the back and front of the housing. The whole thing is glued up like a triple decker sandwich, the prisms being held securely in the cutouts and between the various layers. Work carefully to prism center lines. Be sure that prisms are exactly at right angles since any rotation here will rotate your image twice as much. Prisms must be spotlessly clean and polished. The eyepiece tube is 1 in. in diameter, this size permitting it to work alongside No. 1 prism. Focusing is by means of a spiral groove cut half way across the eyepiece tube as in Fig. 55. Fig. 56 shows the monocular partly assembled and also shows how the turning which joins the main tube to the prism housing is cut away to fit over the second prism. Fig. 53 pic-

tures the finished job covered with a gray pebble-grain oilcloth.

General notes: Cut the main tube long when making any prism telescope. Check the final position of the objective by actually using the instrument; run the eyepiece in as far as it will go and then place the objective so that distant objects are in focus. Then the full focusing range is available for picking up nearer objects. The 23X spotting scope will focus down to about 40 ft.; the 10X monocular to about 30 ft. or even 20 if you want to make it that way. If you use spiral focusing, it is necessary to know in advance how much you will need for focusing. This travel will be very short with a short focus lens, but much longer with a long focus objective. Allow ⅜ in. for lenses less than 10-in. focus; ¾ in., up to 14-in. focus; 1⅛ in. at 18 and 1½ in. at 20. These allowances will let you focus down to 30 or 40 ft. in all cases, possibly closer. When you make a bench setup at close range, remember that this represents the maximum extension of your telescope. If you make a bench setup by focusing on a distant object (this is advisable if you are using an objective of over 20-in. focal length) the setup will represent the telescope at its shortest draw.

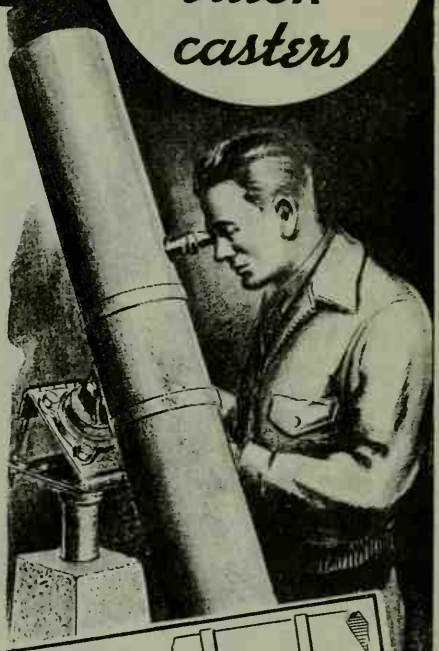
The Kellner type of eyepiece gives best results with all prismatic instruments. The objective should always be a cemented achromat. If the lens is not cemented when you get it, you can dummy test it by cementing with glycerine. Final cementing should be done with Canadian balsam; in a pinch you can use a good grade of water white (clear) lacquer. The diameter of the objective controls the luminosity of the telescope. The diameter of the objective does not control the field of view; except in the Galilean instrument, you can see just as much through a small objective as a large one.



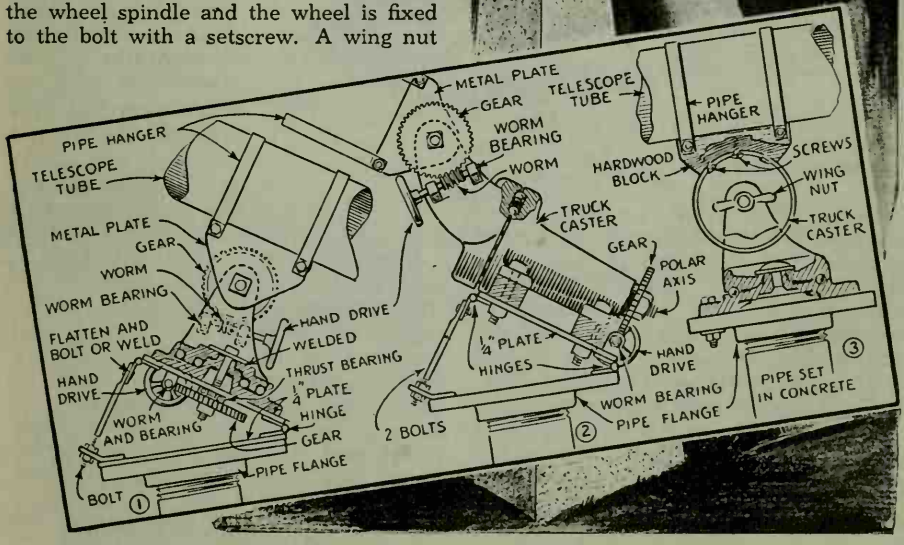


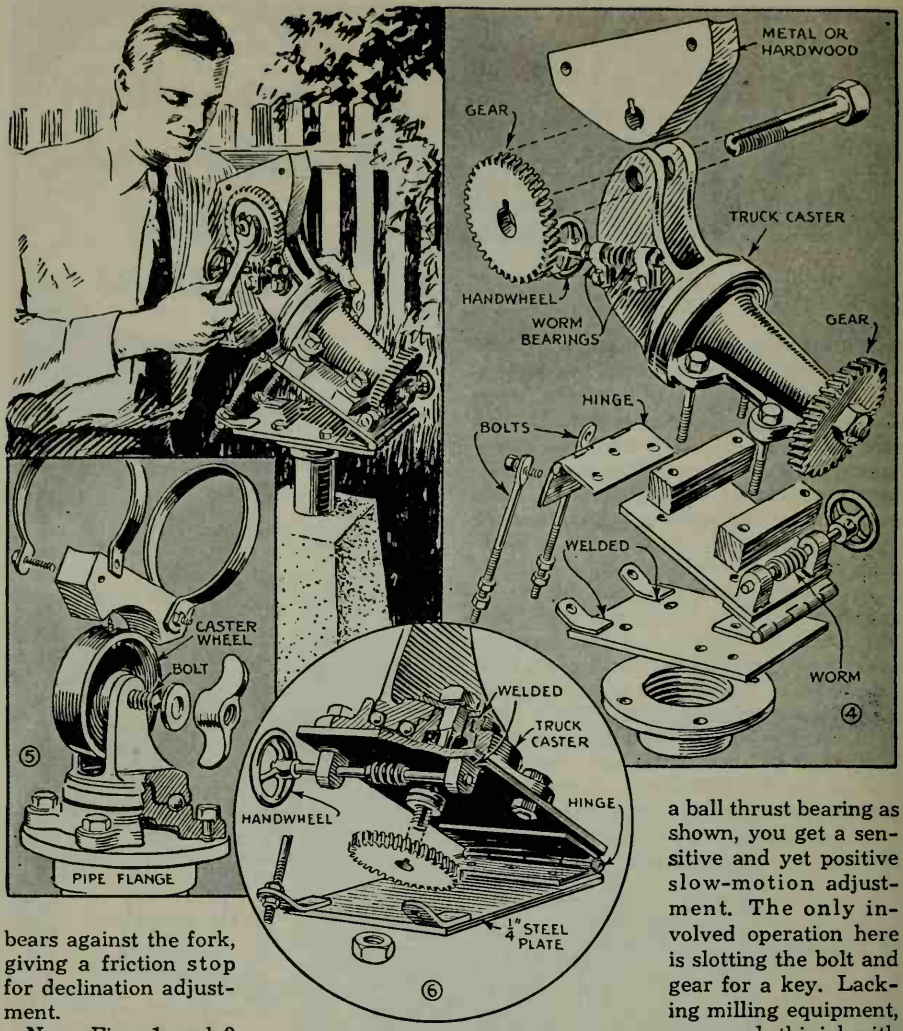
Equatorial TELESCOPE MOUNT

made from ball-bearing truck casters



WHEN you build a vertical or equatorial mounting for either the reflecting or refracting type of telescope, there are two things you are after—rigidity and ease of adjustment. With these two points in mind, it has been found that heavy ball-bearing casters of the type used on hand trucks in manufacturing plants can be made to serve the purpose with a minimum of alteration and very little machine work. These truck casters are not expensive and can be had in various styles fitted with single and double-row ball bearings, some types having ball bearings on both axes. Figs. 3 and 5 show a caster of the single ball-bearing type made into a simple vertical mounting. The telescope tube is attached to the truck wheel by means of a saddle block of hardwood and pipe hangers. A close-fitting bolt is substituted for the wheel spindle and the wheel is fixed to the bolt with a setscrew. A wing nut





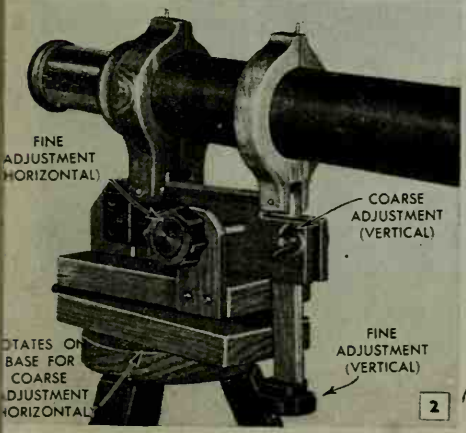
bears against the fork, giving a friction stop for declination adjustment.

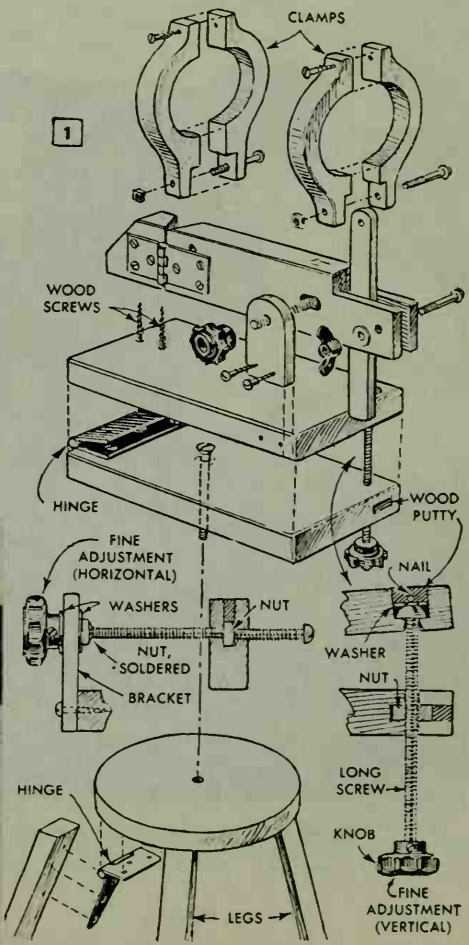
Now, Figs. 1 and 2 and also Figs. 4 and 6 illustrate the method of converting casters into the equatorial-type mounting with slow-motion adjustments on both axes. Although these are somewhat more complicated affairs, you will see that the caster is readily adapted with only a few fittings. The mount shown in Fig. 1 uses a double ball-bearing caster with a flat bolster which is bolted to a steel plate hinged to a pipe flange. By welding the bolt connecting the two halves of the ball races to the lower half and fitting a fine-pitch gear and companion worm over a ball thrust bearing as shown, you get a sensitive and yet positive slow-motion adjustment. The only involved operation here is slotting the bolt and gear for a key. Lacking milling equipment, you can do this job with a hacksaw and then file out a key to fit.

The mount shown in Figs. 2 and 4 is in some respects the best of all those shown. This is largely due to the use of a spindle-type caster which permits placing hand wheels where they are more accessible. Note that the adjustable hinged base is the same as that on the mount shown in Fig. 1. Bearings for the worm spindles are made of flat steel and welded or bolted to the hinged base and to the side of the caster fork. All the mounts shown are designed to be placed on a concrete pedestal.

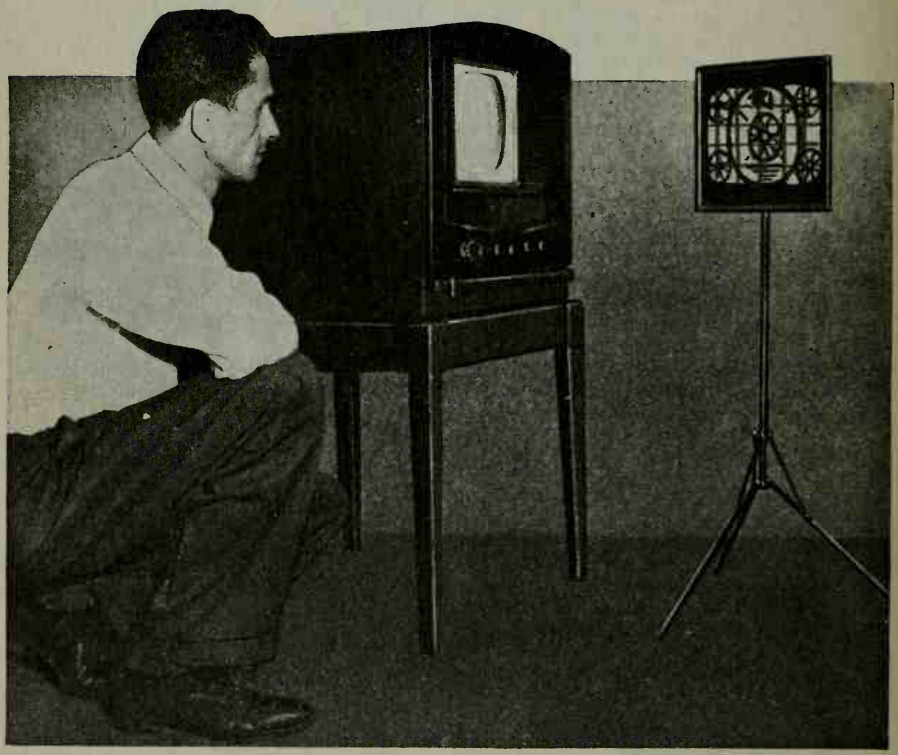
TELESCOPE TRIPOD

BECAUSE of its extreme sensitivity to the slightest body movement, a telescope of 15X or greater must be supported by a steady tripod for the best results. Although simply constructed of hardwood, this tripod features a "pan" head having a micrometer adjustment for both vertical and horizontal movement. These adjustments are attained by means of long machine screws removed from toggle bolts which are turned through fixed nuts. The clamps for the telescope are faceplate-turned in one piece for accuracy on the inner surface and then sawed in half. Contours of the outside of the clamps are jigsawed. The movable base members of the head are hinged together for fine vertical adjustment, the raising and lowering mechanism being shown in the lower right-hand detail, Fig. 1. A hinged mounting bracket for the clamps permits fine horizontal adjustment, using a similar screw arrangement. Coarse adjustments are made by rotating the head on the base and changing the height of the front clamp by loosening the wing nut, Fig. 2. Hardwood legs of the tripod are hinged to a circular toppiece.

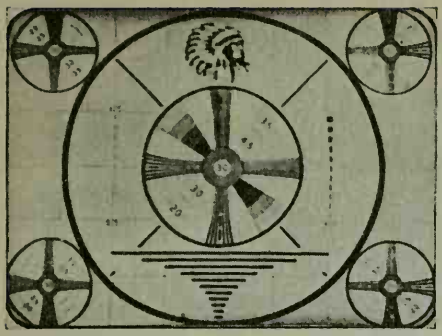




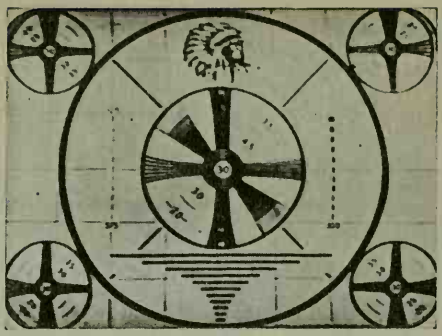
TeleVision



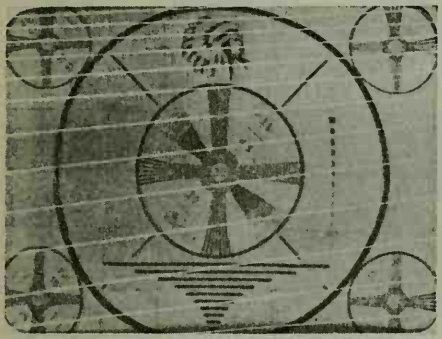
MAKING TV PICTURE CORRECTIONS USING TEST PATTERN REFLECTED BY A MIRROR



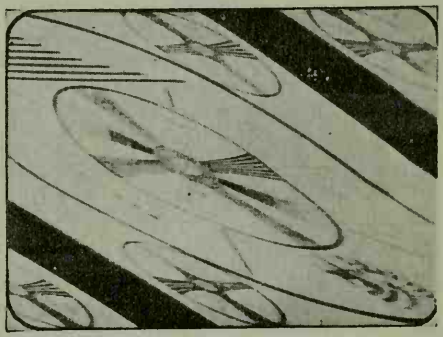
NORMAL PICTURE—Should be in sharp focus, with a good contrast between black and white picture elements with intermediate shades of gray; steady image



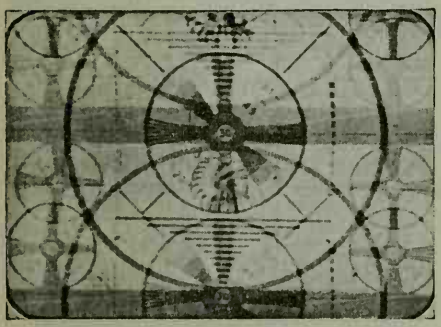
TOO MUCH CONTRAST—Intermediate shades of contrast are dark and do not contrast with black elements. Turn contrast control back, or advance brightness



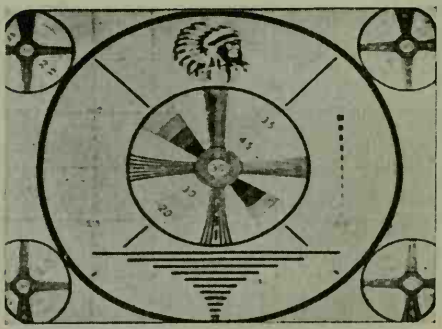
TOO LITTLE CONTRAST—Picture seems to be composed entirely of grays. Turn contrast control clockwise and brightness control counterclockwise to clear



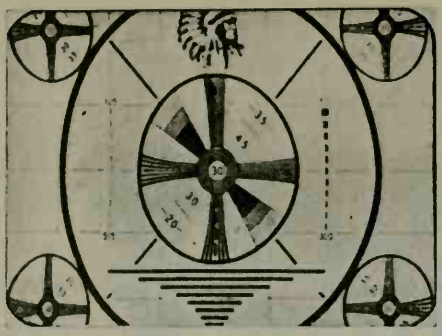
PICTURE TILTS OR MOVES SIDEWAYS—Adjust horizontal hold until picture straightens up and locks into position so that there will be no sideways motion



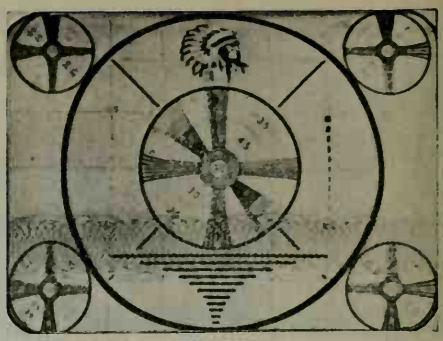
PICTURE MOVES UP AND DOWN—This is a rather common condition and is easily remedied by adjusting the vertical control to stop the rolling picture. No other control need be touched to correct this



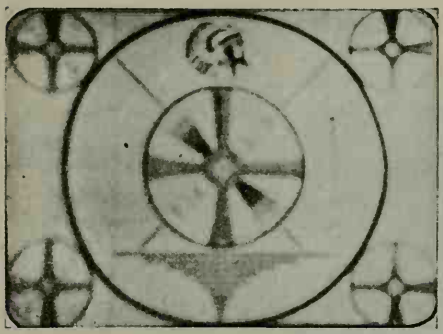
PICTURE TOO WIDE—Adjust the horizontal-size control so that the right and left picture edges are just covered by the mask and centered as shown. The width control is a screen-voltage control



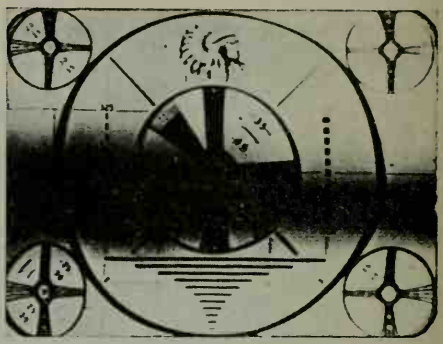
PICTURE TOO TALL—Adjust the vertical-size control so that the top and bottom picture edges are just covered by the mask so that it is centered on screen



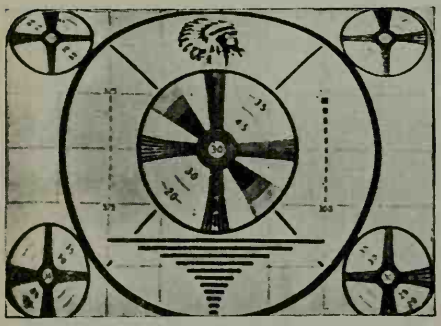
INTERFERENCE FROM DIATHERMY APPARATUS — A broadcasted type of interference that is picked up by the antenna. No receiver adjustment will eliminate it



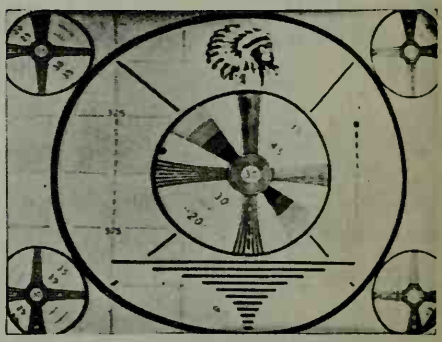
BLURRED PICTURE—This condition indicates that the picture is very definitely out of focus. Adjust the focus control until the picture detail is sharp and clear



INTERFERENCE DUE TO HUM PICKUP IN SET—This can alsa be due to diathermy interference of greater intensity. To correct set hum TV service is indicated



PICTURE ELONGATED VERTICALLY—Adjust the vertical linearity control so that the vertical radii from top to center and center to bottom are equal. This adjustment may slightly alter the vertical size



PICTURE ELONGATED HORIZONTALLY—Adjust horizontal linearity control so that the horizontal radius from center to left side is equal to radius from center to right side (this may alter the horizontal size)

1

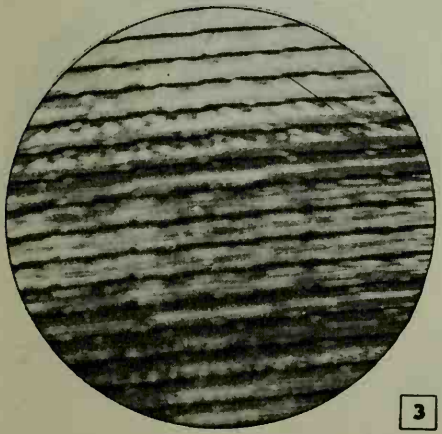
CORRECT

2

TOO BRIGHT

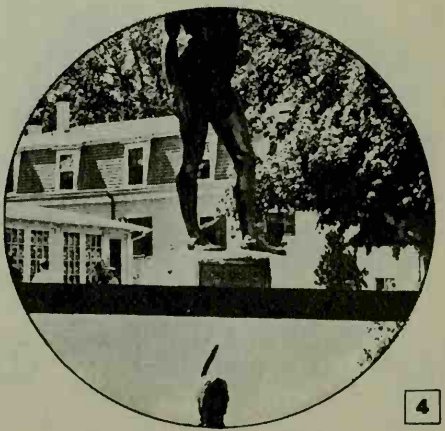
The pictures on this and following pages illustrate the results of incorrect adjustment of various controls on the receiver and also the effects on the actual picture of certain external conditions. Suggested corrections are given if they can be made by the set owner. There are some adjustments that must be made by a television service man. The operating controls are those on the front of the receiver. In some TV sets these are limited to VOLUME, ON-OFF, BRIGHTNESS, CONTRAST and STATION SELECTOR. The brightness control is used to adjust the brilliance of the picture; the contrast control varies the contrast between light and dark portions of the picture. The station-selector knob tunes the set to the desired channel (or station) and it may be turned in either direction. The controls at the rear of the set should be adjusted only by someone who has owned a TV set for some time and is familiar with their functions. Otherwise they should be adjusted by a service man. In no case should a TV set owner remove the back of the set for interior adjustments as extremely high voltages are employed in all TV receivers. All necessary adjustment controls are external at front and rear. The WIDTH control changes the size of the picture horizontally and does not affect the vertical size. The VERTICAL HOLD stops the picture from moving vertically; the HEIGHT control changes the size of the picture vertically and does not affect the horizontal size. The FOCUS control focuses the picture sharply on the face of the picture tube; the

HORIZONTAL MOVEMENT

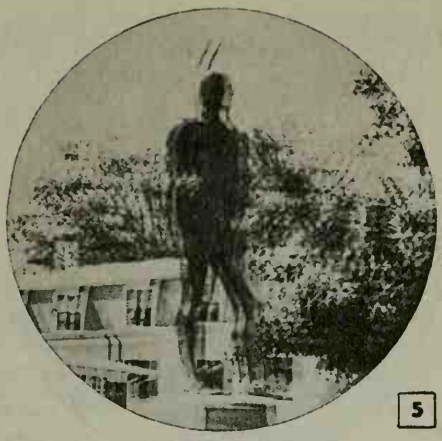


3

VERTICAL MOVEMENT



4



5

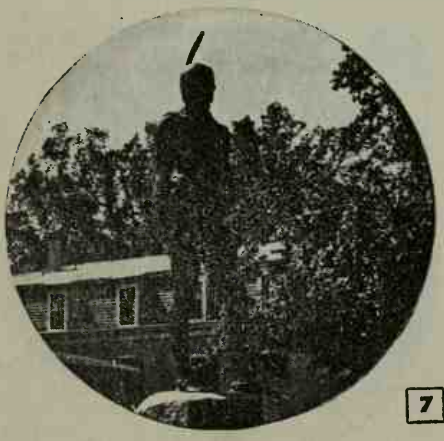
MULTIPLE IMAGES

6

IGNITION INTERFERENCE

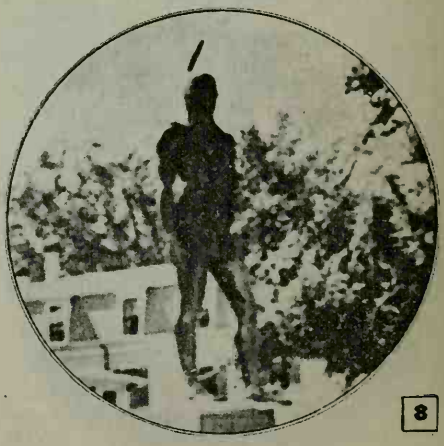
VERTICAL-LINEARITY control provides correct vertical distribution of the TV picture. When you have become familiar with the controls on the front of your TV set it is a simple matter for anyone to tune in a television program. You can learn to do this in a very few minutes after your set is installed. In fact, it is no more difficult to tune than most radio receivers. A common procedure is as follows: turn the set on and permit it to warm up for about 30 seconds. Now rotate the STATION-SELECTOR knob to the station (or channel) for the program that you wish to receive. All newspapers in areas where television programs are available publish a daily list of programs and give the time and channel number of each station in the area. The second step is to turn the CONTRAST control fully counterclockwise; next turn the BRIGHTNESS control fully counterclockwise and then turn it slowly clockwise until the face of the picture tube is illuminated. Now adjust the contrast control until you obtain the proper contrast between blacks and whites. The VOLUME control can then be set for the desired sound level. You now have your TV receiver in correct operating condition and you can switch from one station to another without retuning. However it may be necessary to readjust the CONTRAST control and the fine-tuning control which is combined with the STATION-SELECTOR knob in a dual assembly. Photo No. 1 shows proper picture quality—clear and steady with CORRECT contrast between black, white and gray

TOO MUCH CONTRAST



7

OUT OF FOCUS



8

9

ADJUST WIDTH

10

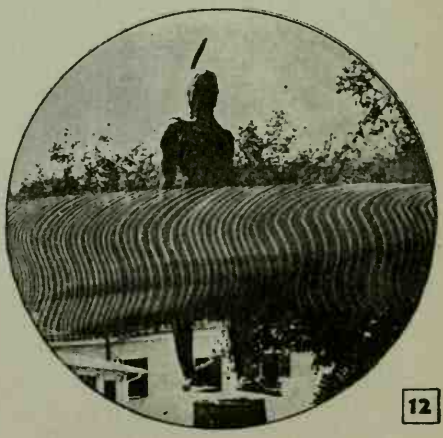
ADJUST HEIGHT

shades. No. 2 is TOO BRIGHT—back off contrast and brightness controls; advance brightness slowly, then adjust contrast. No. 3 shows HORIZONTAL MOVEMENT—adjust horizontal hold control slowly, until picture is steady. No. 4 shows VERTICAL MOVEMENT—when pictures move up and down rapidly, adjust vertical hold for steady picture. No. 5, MULIPLE IMAGES—"ghosts" due to signals reflected from tall buildings, mountains, etc.—these may be minimized by proper antenna orientation. No. 6, IGNITION INTERFERENCE—caused by automobiles or by electrically operated or motor-driven equipment in your immediate vicinity. No. 7, TOO MUCH CONTRAST—adjust same as for "too bright"; then adjust fine tuning and volume if necessary. No. 8, OUT OF FOCUS—adjust focus control for sharpest picture (seldom requires resetting). No. 9, ADJUST WIDTH—shows "side clipping." To correct, adjust width control until picture fills the screen horizontally. No. 10, ADJUST HEIGHT—This is "top and bottom clipping." Adjust height control until picture fills screen vertically. No. 11, R. F. INTERFERENCE—caused by high-powered radio equipment in the vicinity. May be minimized or eliminated by traps, shielding and line filtering. No. 12, DIATHERMY INTERFERENCE—due to certain electrically operated medical equipment; the transmitted "herringbone" pattern may move vertically or remain stationary.

R. F. INTERFERENCE

11

DIATHERMY INTERFERENCE



12